DOCUMENT RESUME

ED 258 028	CE 041 718
AUTHOR	Stotts, Danny
TITLE	Electrician's Helper. Coordinator's Guide. Individualized Study Guide.
INSTITUTION	East Texas State Univ., Commerce. Occupational Curriculum Lab.
SPONS AGENCY	Texas Education Agency, Austin. Dept. of Occupational Education and Technology.
PUB DATE	85
NOTE	142p.
AVAILABLE FROM	Occupational Curriculum Laboratory, East Texas State University, Commerce, TX 75428 (Order No. TI-274-TG).
PUB TYPE	Guides - Classroom Use - Guides (For Teachers) (052)
EDRS PRICE	MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS	Behavioral Objectives; Classroom Techniques; *Competency Based Education; Cooperative Education; *Electrical Occupations; Electrical Systems; Electric Circuits; *Electricity; Electronic Equipment; Equipment Utilization; Guidelines; Hand Tools; Independent Study; *Instructor Coordinators; Learning Activities; Occupational Safety and Health; Safety Equipment; Secondary Education; State Curriculum Guides; Teaching Methods; *Trade and Industrial Education

ABSTRACT

This guide is designed to assist teacher-coordinators supervising cooperative education programs for electrician's helpers in helping students complete a set of individualized, competency-based training activities dealing with electricity and electrical circuits and equipment. The first part of the manual includes a progress chart, a study guide objective, suggested teaching procedures, and answers to tests and assignment sheets provided in the course. Provided in the second part of the guide are 11 information sheets and 18 assignment sheets on such topics as fundamentals of electricity, electrical safety, electrical tools and materials, use of hand tools and power tools, use of solderless connectors and splices, procedures for pulling cable, installation of boxes and switches, electrical fixtures, and metallic tubing. A unit test concludes the volume. (MN)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

TX8413

258028

BEST COPY AVAILABLE

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION
CENTER (ERIC)

☐ This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

● Points of view or opinions stated in this document do not necessarily represent official NIE position or policy.

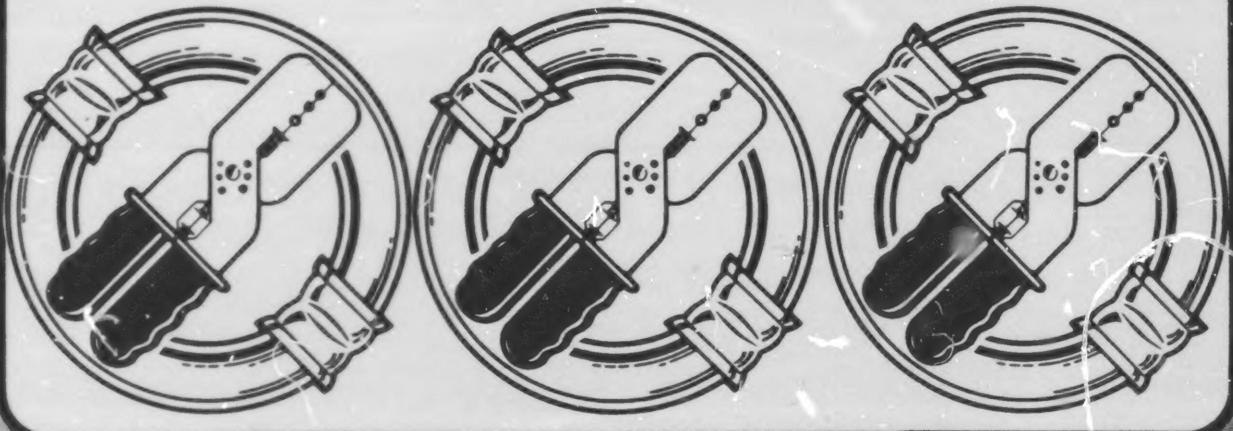
"PERMISSION TO REPRODUCE THIS MATERIAL IN MICROFICHE ONLY HAS BEEN GRANTED BY

D Bristow

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

Coordinator's Guide

Electrician's Helper



CE041718

TI-274-TG

INDIVIDUALIZED STUDY GUIDE

ELECTRICIAN'S HELPER

Coordinator's Guide

Prepared by Danny Stotts

Published by
Occupational Curriculum Laboratory
Center for Vocational Education
Department of Secondary and Higher Education
East Texas State University
Commerce, Texas

in cooperation with
Texas Education Agency
Occupational Education and Technology
Austin, Texas

TI-274-TG

FIRST EDITION

1985

Brand names, company names, trademarks,
or other identifying symbols appearing in the text are
used to clarify and identify and do not constitute a
recommendation or endorsement

To ensure educational equity, the material
has been reviewed to eliminate
bias or stereotyping

OCCUPATIONAL
CURRICULUM
LABORATORY

ETSU an Equal Opportunity University complies
with all federal requirements prohibiting
discriminatory activities

ELECTRICIAN'S HELPER

COORDINATOR'S GUIDE CONTENTS

Foreword v

Progress Chart vii

Study Guide Objective 1

Suggested Teaching Procedures 3

Answers to Assignment Sheets 7

Answers to Test 17

Information and Assignment Sheets

- Information Sheet 1--Fundamentals of Electricity 23
  - Assignment Sheet 1--Fundamentals of Electricity 29
- Information Sheet 2--Electrical Safety 37
  - Assignment Sheet 2--Electrical Safety Survey 43
  - Assignment Sheet 3--Safety Inspection 45
  - Assignment Sheet 4--Identify Five Types of Fire Extinguishers 47
  - Assignment Sheet 5--Make an Electrical Safety Poster 49
- Information Sheet 3--Electrical Tools and Materials 63
  - Assignment Sheet 6--Identify Electrical Conductors 71
  - Assignment Sheet 7--Identify Electrical Tools 73
  - Assignment Sheet 8--Identify Electrical Service Entrance Parts 75
  - Assignment Sheet 9--List the Parts of a Volt-OHM Meter 77
- Information Sheet 4--Using Hand Tools 79
  - Assignment Sheet 10--Using Hand Tools 83
- Information Sheet 5--Using Power Tools 85
  - Assignment Sheet 11--Using Power Tools 89
- Information Sheet 6--Using Solderless Connectors and Making Splices 93
  - Assignment Sheet 12--Using Solderless Connectors and Making Splices . . . 97
- Information Sheet 7--Pulling Cable 103

Assignment Sheet 13--Pulling Cable 107

Information Sheet 8--Box Identification and Installation 109

Assignment Sheet 14--Box Identification and Installation 111

Information Sheet 9--Installation of Receptacles and Switches 121

Assignment Sheet 15--Installation of Receptacles and Switches 129

Information Sheet 10--Electrical Fixtures 133

Assignment Sheet 16--Identify Parts of a Fluorescent Lamp Fixture 137

Assignment Sheet 17--Identify Parts of a Pipe-Supported Lamp Fixture 139

Information Sheet 11--Bending Electrical Metallic Tubing (EMT-Conduit) 141

Assignment Sheet 18--Bending Electrical Metallic Tubing 147

Test 149

FOREWORD

This individualized study guide has been developed for the student who is enrolled in cooperative part-time training and who is employed or desires to be employed as an electrician's helper. The material is designed to provide the general information needed by the student entering the job or to develop an understanding of the job prior to employment.

This study guide is designed to be used by the student on a competency-based, individualized basis, under close supervision of the coordinator. To aid the coordinator in directing the use of these materials, coordinator's guides and student guides are available. By utilizing the progress chart and the answer sheets in the coordinator's guide, the instructor will be able to monitor and grade the progress of the student toward each objective of the curriculum.

Appreciation is expressed to those instructors and business people who contributed their expertise in designing this material and in reviewing the final draft for completeness and accuracy. The assistance of these individuals in the development process assures that the materials are complete, up-to-date, and of use to the teachers in Texas public schools. Special thanks must be extended to Mr. Ronnie Davidson, Electrician, ETSU, and Mr. Theodore Reece, Building Trades Instructor, who reviewed the final draft of this publication.

Special recognition is given to Danny Stotts, CVAE Co-op Coordinator at Mount Pleasant High School, who was the author of this publication and who spent extra effort over and above the contract to prepare the manuscript. Credit is also due to Kathie Wells, Editor, who was responsible for the reading level and format of this publication.

Mention also needs to be made of the support staff, typists, illustrators, and printers who contribute to the development of each publication.

Bill B[illegible]es. Ph.D., Director
Occupational Curriculum Laboratory

Progress Chart for

Electrician's Helper

Name

School

		Date Completed
INFORMATION SHEET 1	FUNDAMENTALS OF ELECTRICITY	
ASSIGNMENT SHEET 1	FUNDAMENTALS OF ELECTRICITY	
Test	Part 1	
OBJECTIVE	Discuss and identify the terms related to electricity, job duties, safety hazards, characteristics, working environments, and employment possibilities of an electrician's helper.	
INFORMATION SHEET 2	ELECTRICAL SAFETY	
ASSIGNMENT SHEET 2	ELECTRICAL SAFETY SURVEY	
ASSIGNMENT SHEET 3	SAFETY INSPECTION	
ASSIGNMENT SHEET 4	IDENTIFY FIVE TYPES OF FIRE EXTINGUISHERS	
ASSIGNMENT SHEET 5	MAKE AN ELECTRICAL SAFETY POSTER	
Test	Part 2	
OBJECTIVE	Point out all safety rules that have to do with electricity.	
INFORMATION SHEET 3	ELECTRICAL TOOLS AND MATERIALS	
ASSIGNMENT SHEET 6	IDENTIFY ELECTRICAL CONDUCTORS	
ASSIGNMENT SHEET 7	IDENTIFY ELECTRICAL TOOLS	
ASSIGNMENT SHEET 8	IDENTIFY ELECTRICAL SERVICE ENTRANCE PARTS	
ASSIGNMENT SHEET 9	LIST THE PARTS OF A VOLT-OHM METER	
Test	Part 3	
OBJECTIVE	Identify the tools and materials used by the electrician's helper.	
INFORMATION SHEET 4	USING HAND TOOLS	

ASSIGNMENT SHEET 10	USING HAND TOOLS	
Test	Part 4	
OBJECTIVE	Choose the correct terminology, safety, and care when using hand tools.	
INFORMATION SHEET 5	USING POWER TOOLS	
ASSIGNMENT SHEET 11	USING POWER TOOLS	
Test	Part 5	
OBJECTIVE	Choose the correct terminology, safety, and care when using power tools.	
INFORMATION SHEET 6	USING SOLDERLESS CONNECTORS AND MAKING SPLICES	
ASSIGNMENT SHEET 12	USING SOLDERLESS CONNECTORS AND MAKING SPLICES	
Test	Part 6	
OBJECTIVE	Identify the different types of solderless connectors and splices and explain how each is used.	
INFORMATION SHEET 7	PULLING CABLE	
ASSIGNMENT SHEET 13	PULLING CABLE	
Test	Part 7	
OBJECTIVE	Identify and discuss the different steps in pulling cable.	
INFORMATION SHEET 8	BOX IDENTIFICATION AND INSTALLATION	
ASSIGNMENT SHEET 14	BOX IDENTIFICATION AND INSTALLATION	
Test	Part 8	
OBJECTIVE	Identify the different types of electrical boxes and their uses.	
INFORMATION SHEET 9	INSTALLATION OF RECEPTACLES AND SWITCHES	
ASSIGNMENT SHEET 15	INSTALLATION OF RECEPTACLES AND SWITCHES	
Test	Part 9	
OBJECTIVE	Identify the different types of receptacles and switches and explain how they are installed.	
INFORMATION SHEET 10	ELECTRICAL FIXTURES	

ASSIGNMENT SHEET 16	IDENTIFY PARTS OF A FLUORESCENT LAMP FIXTURE	
ASSIGNMENT SHEET 17	IDENTIFY PARTS OF A PIPE-SUPPORTED LAMP FIXTURE	
Test	Part 10	
OBJECTIVE	List and explain the different types of electrical fixtures, their parts, and how they are installed.	
INFORMATION SHEET 11	BENDING ELECTRICAL METALLIC TUBING (EMT-CONDUIT)	
ASSIGNMENT SHEET 18	BENDING ELECTRICAL METALLIC TUBING	
Test	Part 11	
OBJECTIVE	Identify electrical metallic tubing types and discuss the different ways of bending that the electrician's helper may be required to do.	

This student has completed the indicated training under my supervision.

Teacher ______________________________

ELECTRICIAN'S HELPER

STUDY GUIDE OBJECTIVE

After completion of this study guide, the student will be able to perform the steps and duties required of an electrician's helper. This knowledge will be evidenced through demonstration and by satisfactorily completing the study guide test.

SPECIFIC OBJECTIVES

In completing this study guide, the student will:

1. Discuss and identify the terms related to electricity, job duties, safety hazards, characteristics, working environments, and employment possibilities of an electrician's helper
2. Point out all safety rules that have to do with electricity
3. Identify the tools and materials used by the electrician's helper
4. Choose the correct terminology, safety, and care when using hand tools
5. Choose the correct terminology, safety, and care when using power tools
6. Identify the different types of solderless connectors and splices and explain how each is used
7. Identify and discuss the different steps in pulling cable
8. Identify the different types of electrical boxes and their uses
9. Identify the different types of receptacles and switches and explain how they are installed
10. List and explain the different types of electrical fixtures, their parts, and how they are installed
11. Identify electrical metallic tubing types and discuss the different ways of bending that the electrician's helper may be required to do

ELECTRICIAN'S HELPER

SUGGESTED TEACHING PROCEDURES

I. Objective Sheet

  A. Discuss each objective with the student.

  B. Explain the relationship of each objective to the student's training station.

  C. Have the student complete the objectives in the most logical sequence for the training station.

  (NOTE: A change of sequence is necessary only if a student changes jobs during the year or an employer requests training in a specific area.)

  D. Add any objectives necessary for the training station.

II. Information and Assignment Sheets

  A. INFORMATION SHEET 1--FUNDAMENTALS OF ELECTRICITY

    1. The first portion of this Information Sheet may be used to provide the student with an overview of the terms and definitions used with electricity.

    2. The second portion of the Information Sheet (items X-XIV) is used to provide the student with specifics concerning the electrician's helper.

    3. Use current Occupational Outlook Handbooks to facilitate future or current outlook of job opportunities in this field.

    4. Use ASSIGNMENT SHEET 1--FUNDAMENTALS OF ELECTRICITY to reinforce the various areas of information.

  B. INFORMATION SHEET 2--ELECTRICAL SAFETY

    1. Discuss all safety terms and rules in complete detail.

    2. Secure safety poster and films for class use.

    3. Use Assignment Sheets 2, 3, 4, and 5 to reinforce this area of information.

  C. INFORMATION SHEET 3--ELECTRICAL TOOLS AND MATERIALS

    1. This information may be used to assist the student in identifying the common tools and materials used by the electrician's helper.

    2. Use Assignment Sheets 6, 7, 8, and 9 to reinforce this area of information.

3. Suggest that the student's employer identify various tools and equipment used at his/her training station.

4. Suggest to the employer that he train the student in correctly using all equipment and tools.

5. Set up contests between class members concerning tool identification.

D. INFORMATION SHEET 4--USING HAND TOOLS

1. This information may be used to assist the student in practicing the correct procedures in hand tool use.

2. Use ASSIGNMENT SHEET 10--USING HAND TOOLS to reinforce this area of information.

3. Bring hand tools to class and actually demonstrate their use.

E. INFORMATION SHEET 5--USING POWER TOOLS

1. This information may be used to assist the student in practicing the correct procedures in power tool operation.

2. Use ASSIGNMENT SHEET 11--USING POWER TOOLS to reinforce this area of information.

3. Bring portable power tools to class for part identification and correct usage.

4. Use films and slides as well as actual demonstrations to illustrate portable power tools.

F. INFORMATION SHEET 6--USING SOLDERLESS CONNECTORS AND MAKING SPLICES

1. This information may be used to help the student identify the different types of solderless connectors and different types of splices.

2. Have the student's employer show the students how to make splices and use solderless connectors.

3. Use ASSIGNMENT SHEET 12--USING SOLDERLESS CONNECTORS AND MAKING SPLICES to reinforce this area of information.

G. INFORMATION SHEET 7--PULLING CABLES

1. This information may be used in assisting the student in the proper procedures of pulling cable.

2. Use ASSIGNMENT SHEET 13--PULLING CABLE to reinforce this area of information.

H. INFORMATION SHEET 8--BOX IDENTIFICATION AND INSTALLATION

1. This information may be used in assisting the student in identifying and installing different electrical boxes.

2. Use ASSIGNMENT SHEET 14--BOX IDENTIFICATION AND INSTALLATION to reinforce this area of information.

I. INFORMATION SHEET 9--INSTALLATION OF RECEPTACLES AND SWITCHES

1. This information may be used to help the student in installing receptacles and switches correctly.

2. Use ASSIGNMENT SHEET 15--INSTALLATION OF RECEPTACLES AND SWITCHES to reinforce this area of information.

3. [illegible] diagram on board with different colored chalk showing wiring [illegible]ceptacles, single pole switches and three-way switches.

J. INFORMATION SHEET 10--ELECTRICAL FIXTURES

1. This information may be used to help the student identify the parts and installation of common electrical fixtures.

2. Use ASSIGNMENT SHEET 16--IDENTIFY PARTS OF A FLOURESCENT LAMP to reinforce this area of information.

K. INFORMATION SHEET 11--BENDING ELECTRICAL METALLIC TUBING

1. This information may be used to assist the student in using the proper procedures in bending metallic tubing.

2. Use ASSIGNMENT SHEET 18--BENDING ELECTRICAL METALLIC TUBING to reinforce this area of information.

III. Answers to Assignment Sheets

A. Some of the Assignment Sheets will vary according to training and should be graded individually.

B. Some Assignment Sheets will not have specific answers but will depend on student participation.

IV. Test

A. Answers are based on total information covered.

B. Various methods may be used in evaluation

C. Include evaluation parts corresponding to any information area or sheets added to the unit.

V. References

A. Building Maintenance-Electrical. Occupational Curriculum Laboratory, East Texas State University.

B. Coordinated Vocational Education and Training-General Construction Trades. Stillwater, OK: State Department of Vocational and Technical Education.

C. Construction Industry Series, Student Manual Preparation and Development. Austin, TX: Texas Education Agency.

D. Construction Industry Series, Instructor's Guide-Preparation Level. Austin, TX: Texas Education Agency.

E. General Construction Trades, Vol. 2. Occupational Curriculum Laboratory, East Texas State University.

F. Mix, Floyd M. House Wiring Simplified. South Holland, IL: The Goodheart-Wilcox Co.

G. Occupational Outlook Handbook. United States Government Printing Office.

H. Understanding Electricity and Electrical Terms. Athens, GA: American Association for Vocational Instructional Materials Engineering Center.

ANSWERS TO ASSIGNMENT SHEETS

ASSIGNMENT SHEET 1

A. 1. Alternating current (AC)--electrical current flowing one way at steady spaces in time

2. Ampere (AMP)--a unit for measuring the strength of an electric current

3. Circuit--the complete path of an electric current, such as from the power source through a lamp and back to the power source.

4. Circuit breaker--a safety device which opens the circuit by tripping a switch instead of burning out the wiring or appliance

5. Conductors--materials through which electrical current flows

6. Current--the flow of electricity in a wire or other conductor

7. Direct current (DC)--electrical current flowing one way at a constant rate

8. Electricity--a kind of energy or power which can be changed into useful form

9. Electric meter--a device which measures the amount of electricity used

10. Fuse--a safety device which burns out when too much current flows through the circuit

11. Ground--a connection to the earth which serves as a return circuit

12. Horsepower (HP)--a unit of mechanical power which is the same as 746 watts of electrical power

13. Hot wires--the wire that carries the electrical current

14. Insulation--a cover over wires to keep electricity from escaping

15. Kilowatt (KW)--1000 watts

16. Kilowatt hour (KH)--1000 watts used for one hour

17. Neutral wire--a wire that does not carry electrical current

18. Resistance (OHM)--electrical friction

19. Short circuit--a side circuit caused by faulty wiring so that the electric current is turned aside from the main circuit

20. Switch--a device used to open or close a circuit

21. Volt (V)--a unit for measuring the force of an electric current

22. Watt (W)--a unit for measuring electric power

23. Watt hour--one watt used for one hour

B. Any four of the following:

1. Lighting
2. Heating
3. Cooling
4. Power
5. Communications

C. Any three of the following:

1. Hydro-electric
2. Gas-fired
3. Coal-fired
4. Atomic

D. Any two of the following:

1. Public owned
2. Privately owned
3. Cooperatives

E. Any two of the following:

1. Transmission
2. Distribution
3. Service

F. 1. 110 Volt: requires two lines running to the house
2. 220 Volt: requires three lines running to the house

G. 1. Pointer and dial
2. Cyclometer

H. Any five of the following:

1. Practices correct safety
2. Installs plugs and switches
3. Hangs electrical switches
4. Bends conduit
5. Installs electrical covers
6. Pulls wire and cables
7. Uses electrical connectors
8. Stores and keeps up tools and equipment
9. Cleans up work area
10. Knows about electrical tools, safety, and general electrical practice
11. Splices wire
12. Removes wire insulation
13. Mounts outlet boxes
14. Tapes splices

I. Any four of the following:

1. Burns
2. Broken bones
3. Sprains
4. Torn muscles
5. Death

J. Any six of the following:

1. Knows correct safety
2. Follows directions
3. Is interested in the job
4. Shows pride in the job
5. Controls temper
6. Is physically and mentally prepared
7. Is willing to move around
8. Is willing to work with others

K. Any four of the following:

1. Under houses
2. In attics
3. At night
4. In weather
5. In dusty as well as damp conditions

L. Excellent

ASSIGNMENT SHEETS 2 AND 3

Evaluated to the satisfaction of the instructor.

ASSIGNMENT SHEET 4

A. Soda-acid
B. Pressurized water
C. Foam
D. Carbon dioxide
E. Dry chemical

ASSIGNMENT SHEET 5

Evaluated to the satisfaction of the instructor.

ASSIGNMENT SHEET 6

A. Metallic armored cable
B. Thermal wire cable
C. Non-metallic cable with ground
D. Lamp cord-braided
E. Power service cord-3 wires
F. Lamp cord (rubber covered)

ASSIGNMENT SHEET 7

Evaluated to the satisfaction of the instructor.

ASSIGNMENT SHEET 8

1. Lead wires
    a. Hot wires
    b. Neutral wires
2. Entrance head
3. Meter box
4. Entrance ell
5. Neutral bar
6. Single-pole breaker
7. Two-pole breaker
8. Main breaker
9. Panel
10. Conduit

ASSIGNMENT SHEET 9

1. Ohms scale
2. VAC, VDC, and MADC scales
3. Selector switch
4. Test leads and jacks
5. Pointer adjustment
6. Ohms adjustment knob
7. Test probes

ASSIGNMENT SHEET 10

A.
1. Straight strip of wood or metal used with a level or for marking a straight line
2. At a 90° angle to a surface
3. Trimming and fitting wood with a sharp-edged tool
4. Making a hole with a drill
5. Making a hole larger than 1/4 inch with an expansion bit
6. Removing the wire edge from sharpened blades with an oilstone
7. The ground or angular surface on a chisel or plane iron
8. The staggering of teeth on a saw so that the body of the saw does not bind
9. The width of the slot the saw leaves in the wood
10. Outward rounded or bell-faced surface
11. Pieces of metal driven into the head of a hammer to keep it in place
12. Straight up and down or vertical position

B.
1. Uses tools correctly.
2. Keeps tools working properly.
3. Check tools before use.
4. Do not carry more tools than you can handle.
5. Do not drop tools.
6. Keep tools sharp.
7. Keep tools clean and dry.
8. Return tools to their proper places when finished.

ASSIGNMENT SHEET 11

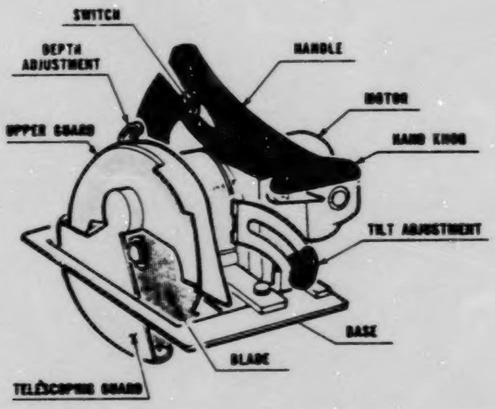
1. The care and upkeep of equipment
2. The speed at which the blade, bit, or cutter of a power tool is moved into the material
3. Light and easily movable tools that are usually hand-held while being used

4. Power source for a power tool
5. Number of turns in a minute of a blade, bit, or cutter in a power tool
6. Keeping hands a certain distance away from the blade, bit, or cutter at all times

B. Any five of the following:

1. Be familiar with how to use each machine.
2. Be alert when using power tools.
3. Make all adjustment with power tools turned off.
4. Do not allow others to distract you.
5. Keep safety guards or covers in place.
6. Wear safety glasses when using or when around power tools.
7. Be sure machines, receptacles, and plugs are properly grounded.
8. Develop a good safety attitude.
9. Know safety zones and do not break any of them.
10. Have permission from your employer or instructor before using power tools.
11. Do needed maintenance on power tools before using.

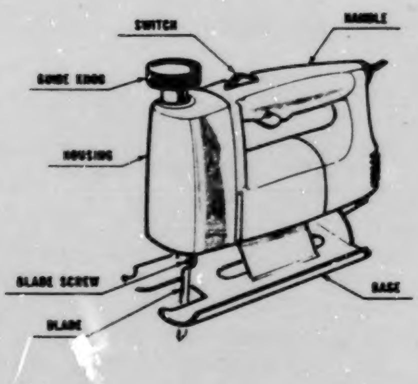
C.



D. Any five of the following:

1. Do not change blades with cord plugged in.
2. Use the right blade.
3. Be sure the work is supported correctly.
4. Do not force the saw into the work.
5. Adjust the depth of cut so that the teeth of the blade will clear the depth of the material about 1/8 inch.
6. Use both hands when sawing.
7. Be careful not to cut into the sawhorse or other clamping device.

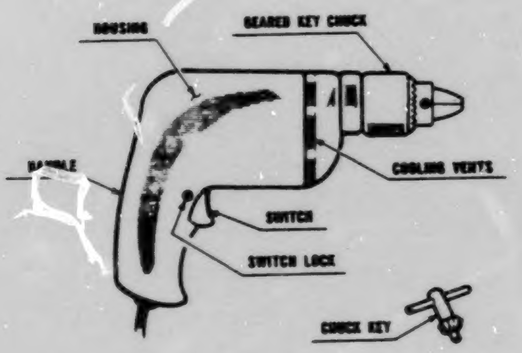
E.


SWITCH
HANDLE
GUIDE KNOB
HOUSING
BLADE SCREW
BASE
BLADE

F. Any five of the following:

1. Select the right blade for your work and saw.
2. Do not cut curves so sharply that the blade will be twisted.
3. Make sure the work is well supported.
4. Do not saw into sawhorse or other supports.
5. Turn on the motor before the blade touches the work.
6. Unplug the saw before making adjustments.
7. Make sure at least two teeth will touch the material being cut at all times.
8. Make sure the blade will saw completely through the material.
9. Keep a light downward pressure on the saw.
10. Turn the saw off and allow the blade to stop before taking the blade from the cut.
11. Take off the blade before storing the saw.

G.


HOUSING
GEARED KEY CHUCK
HANDLE
COOLING VENTS
SWITCH
SWITCH LOCK
CHUCK KEY

H. Any five of the following:

1. Use the right bit.
2. Mount the drill firmly.
3. Do not hammer on the chuck key.
4. Make sure the drill bit turns true.
5. Mount work firmly so it will not turn.
6. Make sure the dirll will provide the correct RPM for the size of the drill bit being used.
7. Hold the drill firmly with both hands.
8. Keep the drill aligned with the hole while drilling.
9. Pull out the drill several times when drilling a deep hole.

ASSIGNMENT SHEET 12

A. Solderless connectors are usually plastic end caps (wire nuts) which are used to hold several electrical wires firmly together without using solder. They are used because they are easy to use and they save time.

B. The size is found by the number and the size of the wire to be joined.

C. 1. Strip the ends of each wire at least 3/4 inch.
   2. Twist the wires together.
   3. Cut off projecting ends.
   4. Screw on the plastic endcaps.

D. Any four of the following:

1. Pigtail splice: simple, most commonly used
2. Western Union: used when connections must be strong enough to support long lengths of heavy wire
3. T-tap splice: used when unable to cut main line
4. Portable cord splice: used only in emergencies, very weak splice
5. Cable splice: used for large stranded cables

ASSIGNMENT SHEET 13

A. Holes should be drilled as straight as possible and in the center.

B. A steel plate of at least 1/16-inch thick must be used to cover the notch.

C. 1. Drill holes from each side at an angle.
   2. Notch the corner studs.
   3. Route cable under the corner.
   4. Route cable over the corner.

D. To avoid wasting of cable

ASSIGNMENT SHEET 14

A. Any four of the following:

1. Metal
2. Plastic
3. Fiber
4. Nylon
5. Rubber

14

B. 1. Handy-used for splices
   2. Switch-used for switches and receptacles
   3. Octagon-used mainly for lighting
   4. Square-used for special purposes as switch-receptacle combination

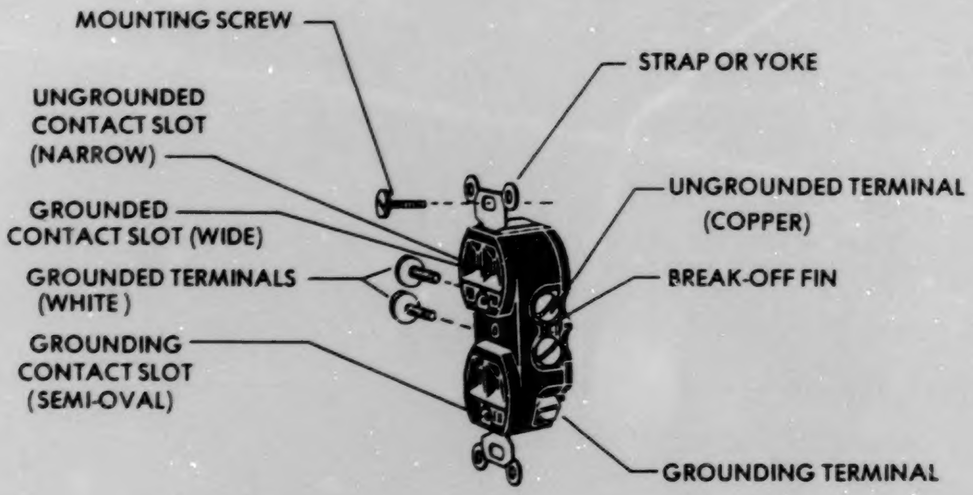
C. 1. T
   2. T
   3. F
   4. F
   5. T
   6. T
   7. T
   8. T
   9. T
   10. T

D. 1. Find where outlet box should go.
   2. Find box mounting holes and recess depth mark on box.
   3. Decide which nail holes to use.
   4. Hold box in desired position with depth mark even with edge of stud.
   5. Drive nails through holes.
   6. Check box to be sure it is held tightly in place.

E. 1. Nail on switch box
   2. Bracket box
   3. Octagon box with bar hanger
   4. Square box--welded construction
   5. Square box--molded construction
   6. Metallic cable clamp
   7. Pri out
   8. Clip
   9. Screw with pigtail
   10. Non-metallic cable clamp

ASSIGNMENT SHEET 15

A.


MOUNTING SCREW
STRAP OR YOKE
UNGROUNDED CONTACT SLOT (NARROW)
UNGROUNDED TERMINAL (COPPER)
GROUNDED CONTACT SLOT (WIDE)
GROUNDED TERMINALS (WHITE)
BREAK-OFF FIN
GROUNDING CONTACT SLOT (SEMI-OVAL)
GROUNDING TERMINAL

B. 1. Remove outside cable insulation about 6 inches.
   2. Strip at least 1 to 1 1/2 inches of insulation from inner cables.
   3. Make a loop on the end of each wire.
   4. Attach the wire loops to the proper screws.
   5. Fasten the receptacle to the box and attach cover.

C. 1. Silver-colored screws indicate neutral.
   2. Bronze-colored screws indicate the hot terminal.
   3. Green screws indicate the ground terminal.

D. 1. Single pole switch
   2. Three-way switch
   3. Dimmer switch
   4. Push-button switch

E. 1. Remove outside cable insulation about 6 inches.
   2. Strip at least 1 to 1 1/2 inches of insulation from inner cables.
   3. Make a loop in the end of each wire.
   4. Attach the wire loops to the proper screws.
   5. Fasten the switch to the box and attach cover.

ASSIGNMENT SHEET 16

1. Fixture
2. Bulb
3. Ballast
4. Starter
5. Holder

ASSIGNMENT SHEET 17

1. Fixture strap
2. Strap mounting screw
3. Threaded pipe
4. Multiple socket
5. Locknut

ASSIGNMENT SHEET 18

A. 1. Usually purchased in bundles of 100 feet
   2. Trades sizes range from 1/2 to 4 inches
   3. Usually cut with a hack saw
   4. Must be deburred with a reamer or file
   5. Two major textures--thin wall and thick wall

B. The conduit hickey is a tool made to bend metal pipe.

C. 1. 45° bends
   2. 90° bends
   3. Back-to-back bends
   4. Offsets
   5. Saddles or double offsets

D. Use a pipe or piece of conduit slightly larger that the EMT needing straightening. Slip over the end of smaller pipe and gently straighten as needed.

ELECTRICIAN'S HELPER

ANSWERS TO TEST

PART 1

A. 1. c
2. e
3. g
4. h
5. a
6. b
7. i
8. d
9. j
10. l
11. f
12. k

B. Any four of the following:

1. Lighting
2. Heating
3. Cooling
4. Power
5. Communications

C. 1. x
2. x
3.
4. x

D. 1. x
2.
3. x
4. x

E. 1. x
2.
3. x
4. x

F. 1. 2
2. 1
3. 3

G. 1. 220
2. 110

H. Any two of the following:

1. Residential
2. Commercial
3. Special
4. Fuel adjustment

I. 1. Pointer
2. Cyclometer

J. Any ten of the following:

1. Practices correct safety
2. Installs plugs and switches
3. Installs electrical covers
4. Bends conduit
5. Pulls wire and cables

6. Uses different types of connectors
7. Splices wire
8. Cleans up work areas
9. Stores and keeps up tools
10. Assists in hanging fixtures
11. Knows about electrical tools, safety, and general electrical practices
12. Removes wire insulation
13. Mounts outlet boxes
14. Tapes splices

K. Any three of the following:

1. Burns
2. Broken bones
3. Sprains
4. Death

L. Any five of the following:

1. Knows correct safety
2. Follows directions
3. Is interested in the job
4. Shows pride in the job
5. Controls temper
6. Is physically and mentally prepared
7. Is willing to move around
8. Is willing to work with others

PART 2

A. 1. b
2. c
3. a
4. c
5. i
6. d
7. h
8. j
9. f
10. g
11. k
12. l

B. 1. x
2. x
3. x
4. x
5. x

C. 1. x
2.
3. x
4. x
5.
6. x

D. 1. Class A
2. Class B
3. Class C

E. 1. Class A only
2. Class A only
3. Class A and B
4. Class A, B, or C
5. Class A, B, or C

PART 3

A. 1. a
2. b
3. c
4. d

B. 1. x
2. x
3. x
4. x
5. x

C. 1. x
2. x
3.
4. x
5. x

D. 1. x
2. x
3. x
4. x
5.

E. Any three of the following:

1. Single pole
2. Three-way
3. Quiet
4. Mercury

F. 1. x
2. x
3. x
4.
5. x

G. 1. h
2. f
3. e
4. l
5. j
6. k
7. d

H. 1. x
2. x
3.
4.
5. x
6. x

I. 1. e
2. d
3. c
4. a
5. b

J. 1. Ohms scale
2. VAC, VDC, MADC scales
3. Selector switch
4. Test leads and jacks
5. Pointer adjustment
6. Ohms adjustment knob
7. Test probes

PART 4

A. 1. f
2. d
3. a
4. g
5. h
6. b
7. e
8. c
9. i
10. l
11. j
12. k

B. 1. T
2. T
3. F
4. F
5. T
6. F
7. F
8. T

PART 5

A. 1. e
2. f
3. a
4. b
5. c
6. d

B. 1. x
2. x
3. x
4. x
5.
6. x
7. x
8. x
9.
10. x
11.

C.
1. Hand knob
2. Base
3. Switch
4. Telescoping guard
5. Motor
6. Blade
7. Handle
8. Upper guard
9. Depth adjustment
10. Tilt adjustment

D.
1. safe
2. unsafe
3. safe
4. unsafe
5. unsafe
6. safe
7. unsafe

E.
1. Switch
2. Handle
3. Blade
4. Housing
5. Base
6. Blade screw
7. Guide knob

F.
1. unsafe
2. unsafe
3. unsafe
4. safe
5. unsafe
6. unsafe
7. unsafe
8. safe
9. unsafe
10. unsafe

G.
1. Housing
2. Switch
3. Handle
4. Chuck key
5. Cooling vents
6. Switch lock
7. Geared key chuck

H.
1. safe
2. safe
3. unsafe
4. safe
5. safe
6. safe
7. unsafe
8. safe
9. unsafe

PART 6

A.
1. F
2. T
3. F
4. T
5. T

B.
1. Strip the ends of each wire at least 3/4-inch.
2. Twist the wires together.
3. Cut off projecting ends.
4. Screw on the plastic endcaps.

C.
1. T
2. F
3. F
4. T
5. T

PART 7

A.
1. T
2. T
3. F
4. F
5. F
6. T
7. T
8. T

PART 8

A. 1. Metal
2. Plastic
3. Fiber
4. Nylon
5. Rubber

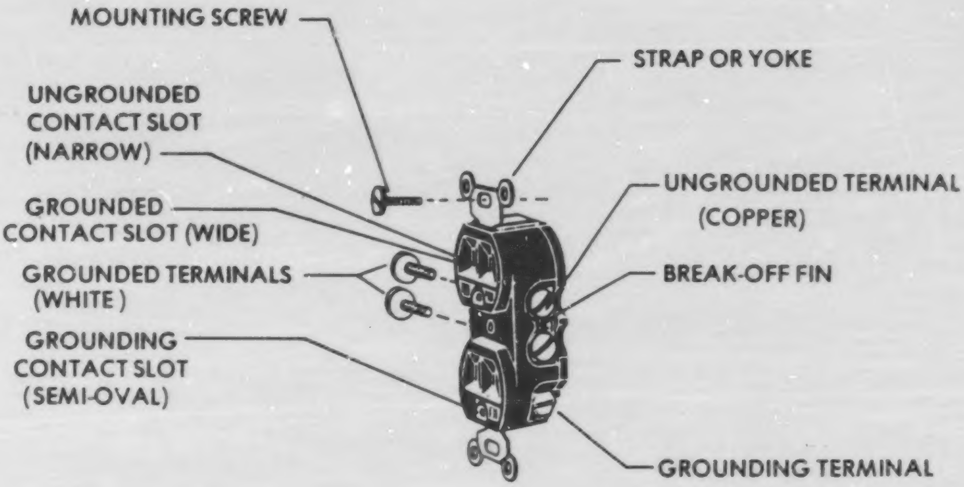
B. 1. Handy (used for splices)
2. Switch (used for switches and receptacles)
3. Octagon (used for lighting and fixtures)
4. Square (used with covers designed for special purposes such as switch-receptacle combination)

C. 1. Must be installed at every point where cable will be spliced or cut off
2. Usually secured by nails driven through back of box or through straps
3. Straps may be mounted on the side or front of box, depending on where the box is located
4. Bar hangers are used extensively in ceilings
5. Boxes can be bought with threaded holes for grounding screws, with screws with pigtails, or with grounding clips

D. 1. 2
2. 4
3. 6
4. 3
5. 1
6. 5

PART 9

A.


MOUNTING SCREW
STRAP OR YOKE
UNGROUNDED CONTACT SLOT (NARROW)
UNGROUNDED TERMINAL (COPPER)
GROUNDED CONTACT SLOT (WIDE)
GROUNDED TERMINALS (WHITE)
BREAK-OFF FIN
GROUNDING CONTACT SLOT (SEMI-OVAL)
GROUNDING TERMINAL

B. 1. b
2. c
3. a

C. 1. Single pole switch
2. Three-way switch
3. Dimmer switch
4. Push-button switch

PART 10

A. 1. Fluorescent
   2. Chandeliers
   3. Recessed
   4. Ceiling fixtures
   5. Outdoor fixtures

B. 1. Bulb
   2. Ballast
   3. Starter
   4. Holder
   5. Starter socket

C. 1. Strip insulation from cables.
   2. Use wire nuts to splice wires together.
   3. Attach mounting screws while holding the fixture's weight.
   4. Tighten the mounting screws, but do not overtighten.
   5. Attach globes and other decorations.

PART 11

A. 1. T
   2. F
   3. F
   4. F
   5. T
   6. T
   7. T
   8. T
   9. T
   10. F

B. 1. Make a 90° bend.
   2. Mark the distance on the tubing as D.
   3. Reverse the direction of the bender.
   4. Raise the bender to make the second 90° bend on the mark.

INFORMATION SHEET 1--FUNDAMENTALS OF ELECTRICITY

I. Terms and Definitions

A. Alternating current (AC)--electrical current flowing one way at steady spaces in time

B. Ampere (AMP)--a unit for measuring the strength of an electric current

C. Circuit--the complete path of an electric current, such as from the power source through a lamp and back to the power source

D. Circuit breaker--a safety device which opens the circuit by tripping a switch instead of burning out the wiring or appliance

(NOTE: A circuit breaker can be reset after cooling.)

E. Conductors--materials through which electrical current flows

F. Current--the flow of electricity in a wire or other conductor

G. Direct current (DC)--electrical current flowing one way at a constant rate

H. Electricity--a kind of energy or power which can be changed into useful form

I. Electric meter--a device which measures the amount of electricity used

J. Fuse--a safety device which burns out when too much current flows through the circuit

K. Ground--a connection to the earth which serves as a return circuit

(NOTE: Ground wires also prevent electrical shock.)

L. Horsepower (HP)--a unit of mechanical power which is the same as 746 watts of electrical power

M. Hot wires--the wire that carries the electrical current

N. Insulation--a cover over wires to keep electricity from escaping

O. Kilowatt (KW)--1000 watts

P. Kilowatt hour (KWH)--1000 watts used for one hour

Q. Neutral wire--a wire that does not carry electrical current

R. Resistance (OHM)--electrical friction

S. Short circuit--a side circuit caused by faulty wiring so that the electric current is turned aside from the main circuit

T. Switch--a device used to open or close a circuit

U. Volt (V)--a unit for measuring the force of an electric current

V. Watt (W)--a unit for measuring electric power

W. Watt hour--one watt used for one hour

II. Uses of Electricity

A. Lighting

B. Heating

C. Cooling

D. Power

E. Communications

III. Types of Electrical Power Plants

A. Hydro-electric plants

B. Gas-fired electric plants

C. Coal-fired electric plants

D. Atomic generated plants

IV. Types of Individually Owned Electrical Generators

A. Wind powered

B. Gasoline powered

C. Solar powered

V. Types of Power Companies

A. Publicly owned

B. Privately owned

C. Cooperatives

VI. Types of Power Lines (See Illustration Sheets 1 and 2)

A. Transmission lines--electrical lines that go from the generating plant to sub-station or distribution center

B. Distribution lines--electrical lines that begin at the sub-station or distribution center and go to the user

(NOTE: Usually running under 20 miles)

C. Service lines--electrical lines that run from the meter to the point of use (for example: a house)

VII. Different Electrical Services

A. 110-volt--requires two lines running to the house; used for lights and small appliances, such as toasters or irons

B. 220-volt--requiring three lines running to the house; used for large appliances such as ranges and air conditioners

VIII. Electricity Rates

A. Residential

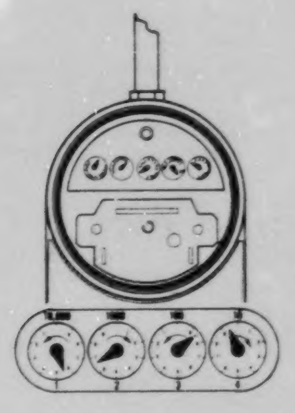
B. Commercial

C. Special

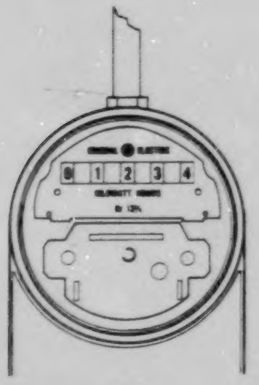
D. Fuel adjustment

IX. Types of Electric Meters

A. Pointer and dial



B. Cyclometer



X. Job Duties of an Electrician's Helper
  A. Practices correct safety
  B. Installs plugs and switches
  C. Assists in hanging electrical fixtures
  D. Installs electrical covers
  E. Bends conduit (tube for protecting electric wires)
  F. Pulls wire and cables
  G. Uses different types of electrical connectors
  H. Stores and keeps up electrical tools and supplies
  I. Cleans up work area
  J. Knows about electrical tools, safety, and general electrical practices
  K. Splices wires
  L. Removes wire insulation
  M. Mounts outlet boxes
  N. Tapes splices

XI. Dangers of the Job
  A. Burns caused by electrical shorts
  B. Broken bones and bruises from falls
  C. Sprains and muscle tears caused by handling heavy equipment
  D. Death from unsafe working habits

XII. Special Qualities Needed by an Electrician's Helper
  A. Knows correct safety
  B. Follows directions
  C. Is interested in the job
  D. Shows pride in the job
  E. Controls temper
  F. Is physically and mentally prepared

G. Is willing to move around

H. Is willing to work with others

XIII. Where an Electrician's Helper Works

A. Under houses

B. In attics

C. At night

D. In weather

E. In dusty as well as damp conditions

XIV. Job Outlook for the Electrician's Helper is Excellent

A. More total electric homes are being built.

B. More electrical appliances are being used.

C. Many electrician's helpers are retiring and others are becoming skilled electricians.

ASSIGNMENT SHEET 1--FUNDAMENTALS OF ELECTRICITY

A. Write a short definition for each of the following words.

1. Alternating current--

2. Ampere--

3. Circuit--

4. Circuit breaker--

5. Conductors--

6. Current--

7. Direct current--

8. Electricity--

9. Electric meter--

10. Fuse--

11. Ground--

12. Horsepower--

13. Hot wires--

14. Insulation--

15. Kilowatt--

16. Kilowatt hour--

17. Neutral wire--

18. Resistance--

19. Short--

20. Switch--

21. Volt--

22. Watt

23. Watt hour--

B. List four uses of electricity.

1.
2.
3.
4.

C. List three types of electrical power plants.

1.
2.
3.

D. List two types of power companies.

1.
2.

E. List two types of power lines.

1.
2.

F. List and tell the difference between the two common electrical services:

1.
2.

G. List the two types of electric meters.

1.
2.

H. List five job duties of an electrician's helper.

1.
2.
3.
4.
5.

I. List four job dangers for the electrician's helper.

1.
2.
3.
4.

J. List six required special qualities needed by an electrician's helper.

1.

2.

3.

4.

5.

6.

K. List four places where the electrician's helper works.

1.

2.

3.

4.

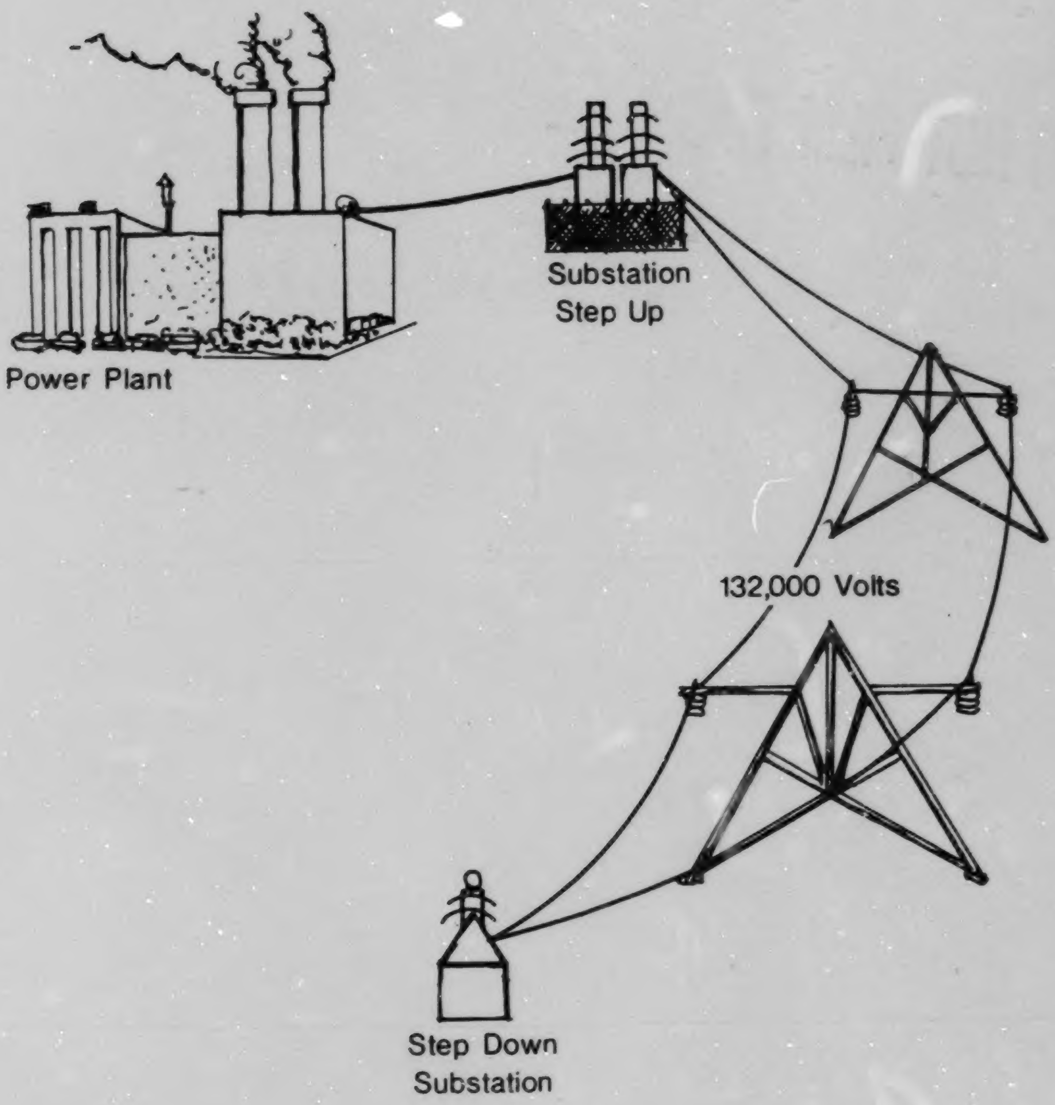
L. What is the job outlook for electrician's helpers? Check the correct answer.

_____ 1. Good

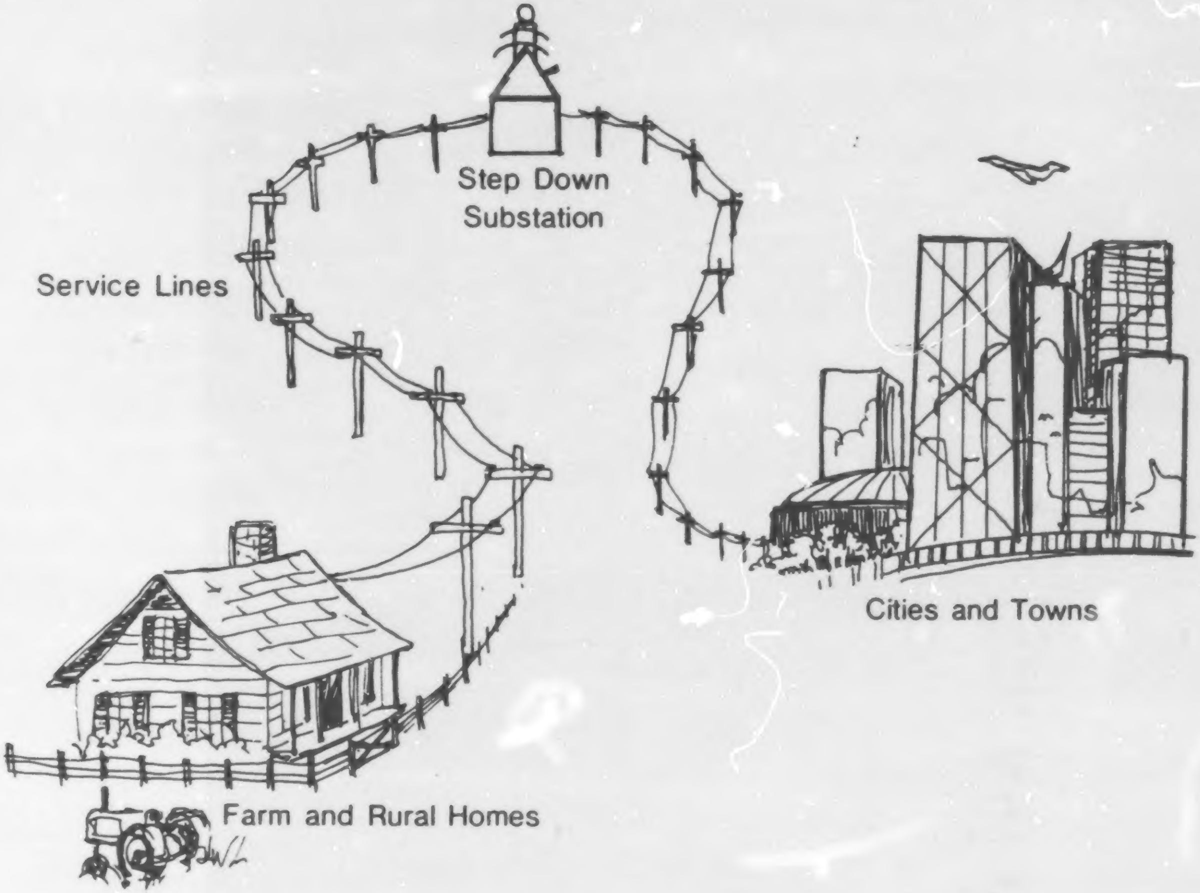
_____ 2. Excellent

_____ 3. Poor

TRANSMISSION LINES FROM GENERATOR TO HOME USE


Power Plant
Substation
Step Up
132,000 Volts
Step Down
Substation

DISTRIBUTION LINES FROM GENERATOR TO HOME USE


Step Down
Substation
Service Lines
Cities and Towns
Farm and Rural Homes

INFORMATION SHEET 2--ELECTRICAL SAFETY

I. Terms and Definitions

- A. Accident--any unplanned event which causes injury or damage
- B. Safety--state of being free from danger, risk, or injury
- C. Electrical shock--electric current passing through a person's body
- D. Defective--not working correctly; faulty
- E. Approved--said to meet the least possible rules
- F. Ground--a connection to the earth which serves as a return circuit and reduces danger
- G. Short circuit--a side current caused by faulty wiring so that the electric current is turned aside from the main circuit
- H. Overload--a circuit forced to carry more electric current than it is made to carry
- I. Live wire--current-carrying wire

  (NOTE: Current kills!)
- J. Dead circuit--a disconnected circuit, usually caused by taking out a fuse, tripping a breaker, or unhooking service
- K. Modification--a slight change in form or use
- L. Qualified person--a person who knows the work area involved

II. Effect of Electrical Accidents

- A. Shock
- B. Burns
- C. Falls and spills
- D. Cuts and bruises

III. Results of Electrical Accidents

- A. Death--One ampere for one second of contact can cause death.
- B. Crippling--Severe burns can cause loss of limb, sight, or mobility.

C. Loss of time--Accidents caused by electricity make up 4% of job time lost in the U.S. each year.

D. Loss of material--Fire caused by electricity causes millions of dollars of material loss each year.

E. Loss of job--Most employers will not keep a dangerous worker on the job.

IV. Common Causes of Electrical Accidents

A. Human failure--not using safe work practices (See IS-3)

B. Failure to handle tools correctly--not making necessary repairs to faulty equipment (See IS-4)

C. Carelessness--not observing safety rules (See IS-5)

D. Modification--making changes in equipment without being told to do so

(NOTE: Never overload a circuit! This increases the chance of an electrical fire.)

E. Misuse--using something in a wrong way (See IS-6)

F. Defective equipment

1. Ground wire

a. Missing

b. Broken

c. Not connected correctly

d. Not connected at all

2. Insulation

a. Wet--good electrical conductor

b. Worn--good chance of shock

c. Cut--good chance of shock

d. Oily--good electrical conductor

G. Faulty tools

1. Broken guard--do not use

2. Damaged power cord--repair; do not use

3. Improper or no switch; do not use

4. Broken handle--repair; do not use

5. Loose fasteners--repair; do not use

H. Ignorance--not knowing the correct thing to do

(NOTE: Ask someone--there are no second chances with electricity.)

V. Electrical Shock Victims (See IS-7)

A. If possible, turn OFF electricity causing shock.

B. Remove hot wire from victim by using something made of dry wood, plastic, glass, or fiberglass.

CAUTION: Never touch the victim. You will also receive the shock.

C. Remove victim from source of electricity after protecting yourself with thich layers of dry paper or cloth. You could be shocked just by touching the victim.

D. Give mouth-to-mouth resuscitation.

E. Call an ambulance or doctor.

F. Notify the power company.

G. Watch for possible electrical fires.

VI. Classes of Fires

A. Class A--caused by ordinary burnable materials, such as rags, paper, and wood

B. Class B--caused by flammable liquids, such as gasoline, oil, and paint thinner

D. Class C--electrical fires in wires or electrical motors

VII. Types of Fire Extinguishers (See IS-8)

A. Soda-acid--Use on Class A fires only.

B. Pressurized water--Use on Class A fires only.

C. Foam--Use on Class A and B fires only.

D. Carbon dioxide--Use on Class A, B, or C fires.

E. Dry chemical--Use on Class A, B, or C fires.

VIII. Work Area Safety Factors

A. Keep work area free of loose tools.

B. Keep work area free of loose materials and trash.

C. Keep floors free of water, oil, grease, and other liquids.

D. Work only on dead circuits.

E. Practice good housekeeping and work habits.

IX. Tool and Equipment Safety Factors

A. Operate equipment properly.

B. Use clean tools.

C. Use insulated handles to prevent shock.

D. Keep cutting tools sharp.

E. Use the right tools for the job to be done.

X. Electrical Installation Safety Factors

A. Check circuit with test light before starting work.

B. Keep all equipment and tools dry.

CAUTION: This is a MUST!

C. Work on only one side of a circuit at a time.

D. Insulate your body when working with live wires by wearing:

1. Lineman's gloves
2. Rubber-soled shoes
3. Approved electrical worker's hard hat

E. Work on dead circuit (the electricity is turned OFF)

F. Ladders

1. Use wooden ladders that are not painted and in good repair. Painting ladders covers cracks or breaks.

CAUTION: DO NOT use metal ladders for electrical work because you could get an electrical shock. Metal is an excellent conductor of electricity.

2. Place ladder one-fourth of the ladder's length away from wall.

3. Be sure all feet of folding ladders are level on the ground or floor so the ladder is steady.

G. Cut away from your body when stripping wire with a knife.

XI. Special Steps for Safety

A. DO NOT go around breakers or fuses with "jumpers."

B. DO NOT install higher amp-rated fuse or breaker than should be used.

C. DO NOT place coins or foil behind a fuse.

D. DO NOT overload a circuit.

(NOTE: Failure to follow these simple rules could cause a major fire, shock, or death. Electricity is not a toy--your life is in its grasp. Respect it!)

ASSIGNMENT SHEET 2--ELECTRICAL SAFETY SURVEY

Directions: Look around your training station to see if you can find any unsafe electrical conditions. List any dangers you find. Be sure to check all wall outlets, switches, motors, tools, and extension cords. Your survey will be used to help make your training station a safer place to work.

ASSIGNMENT SHEET 3--SAFETY INSPECTION

Directions: Look around your home and garage and see if you can find any unsafe electrical conditions. Make a note of any you find and bring your list to class. The following are some of the things you may want to look for.

A. Extension cords hung over nails

B. Worn or frayed electrical cords

C. Switches not working correctly

D. Light bulbs near flammable materials

E. Outlets overloaded

F. Electrical cords under rugs or on floor in places where many people walk

G. Television set near flammable material

H. Outlets in poor condition, with no covers

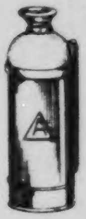
I. Fuse box with improper fuses

J. Appliances not grounded

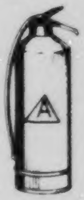
K. Main switch hard to reach

ASSIGNMENT SHEET 4--IDENTIFY FIVE TYPES OF FIRE EXTINGUISHERS

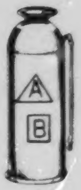
Directions: Identify the five types of fire extinguishers shown below by looking at Illustration Sheet 7. Write the name of each in the blank.



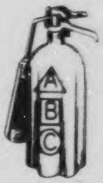
A. ______________________________



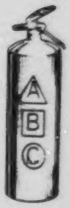
B. ______________________________



C. ______________________________



D. ______________________________



E. ______________________________

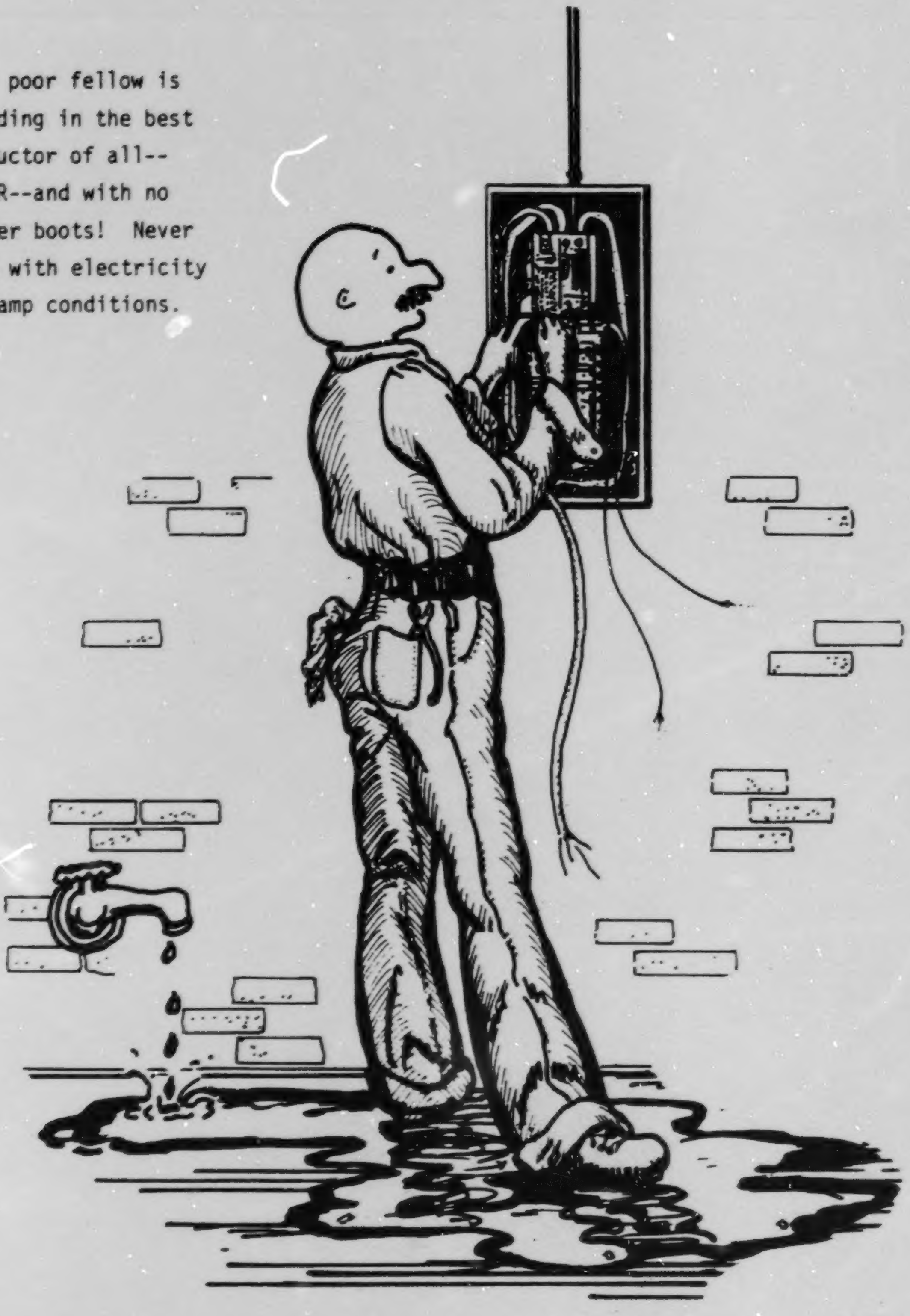
ASSIGNMENT SHEET 5--MAKE AN ELECTRICAL SAFETY POSTER

Directions: On a piece of poster board or a sheet of typing paper, make a poster about electrical safety. You may want to use some of the rules listed in the Information Sheet for ideas in making your poster.

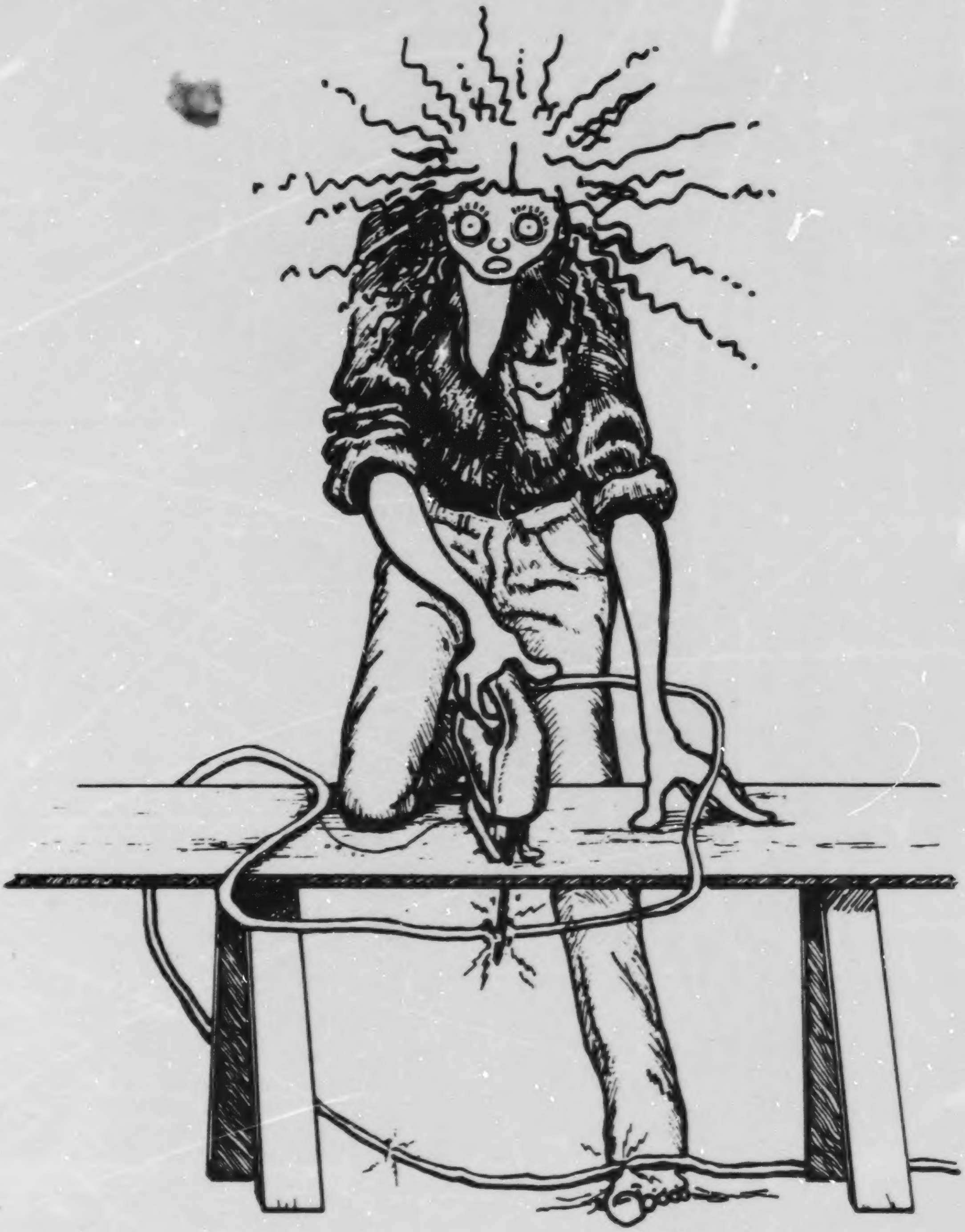
(NOTE: The instructor may want to display your poster as a safety reminder.)

ELECTRICITY MUST BE RESPECTED!

This poor fellow is standing in the best conductor of all--WATER--and with no rubber boots! Never work with electricity in damp conditions.

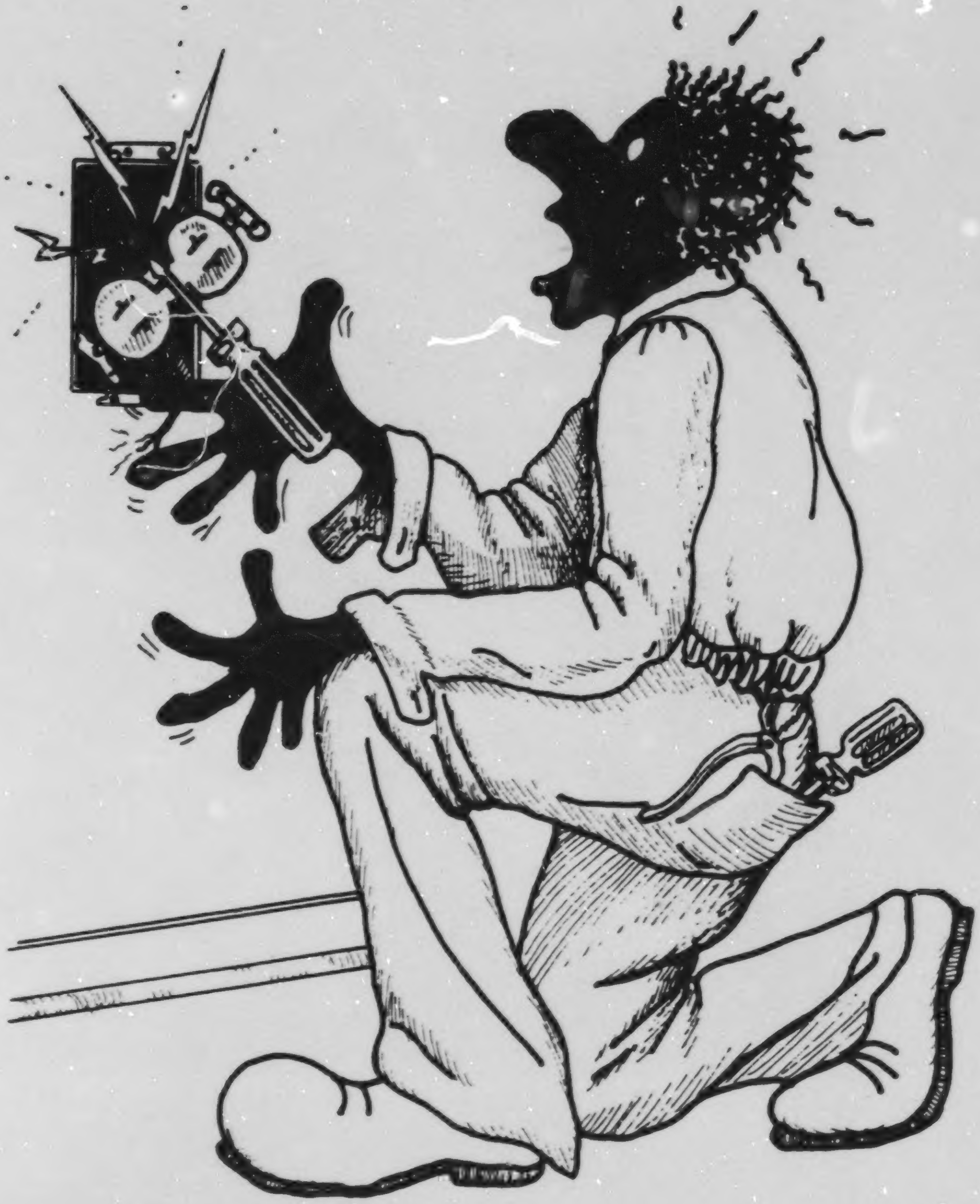


FAILURE TO HANDLE POWER TOOLS CORRECTLY.



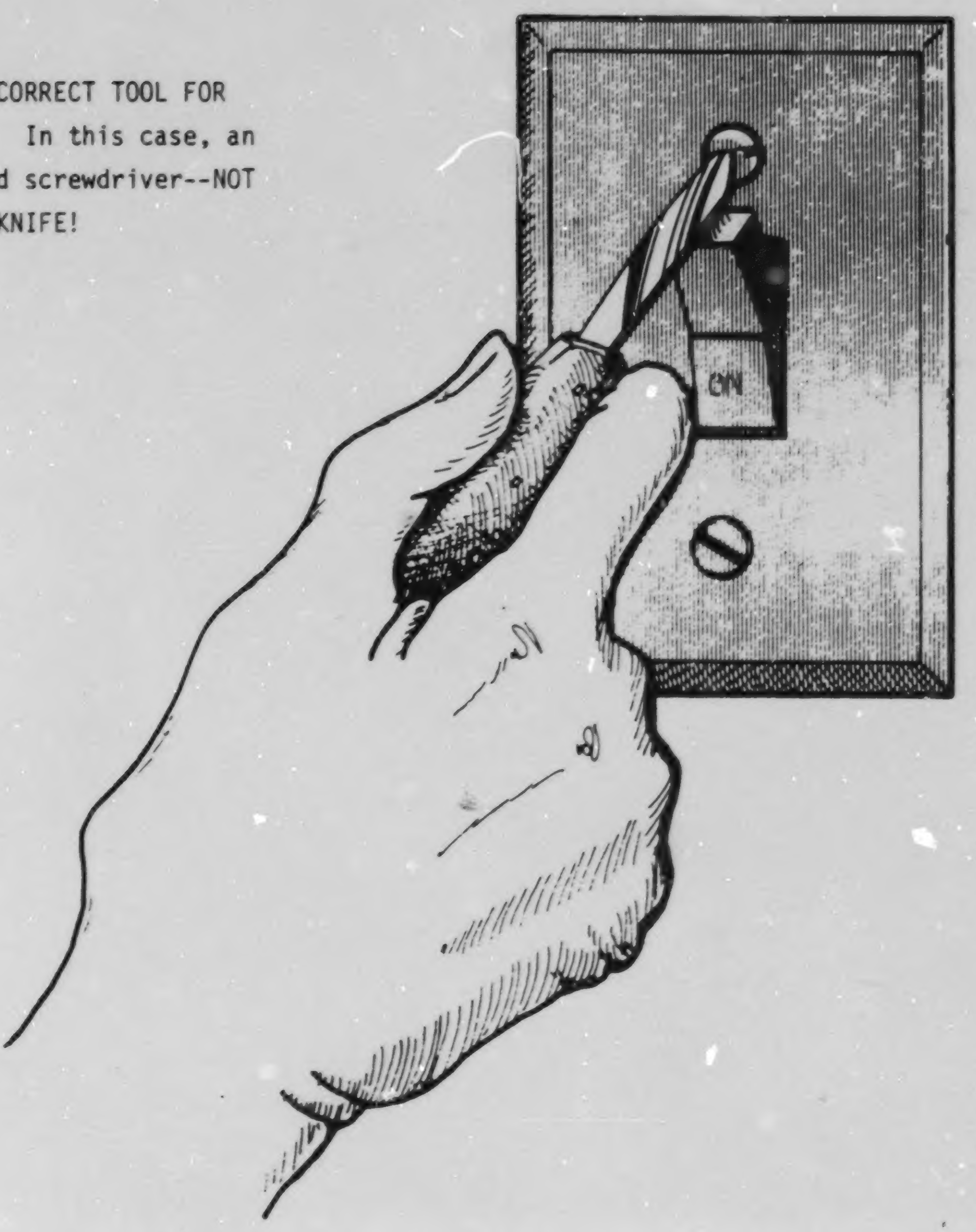
CARELESSNESS

ALWAYS SHUT POWER OFF!
DO NOT WORK ON LIVE CIRCUITS!
Test circuit by using testors or small appliance. Leave nothing to chance when working with electricity.

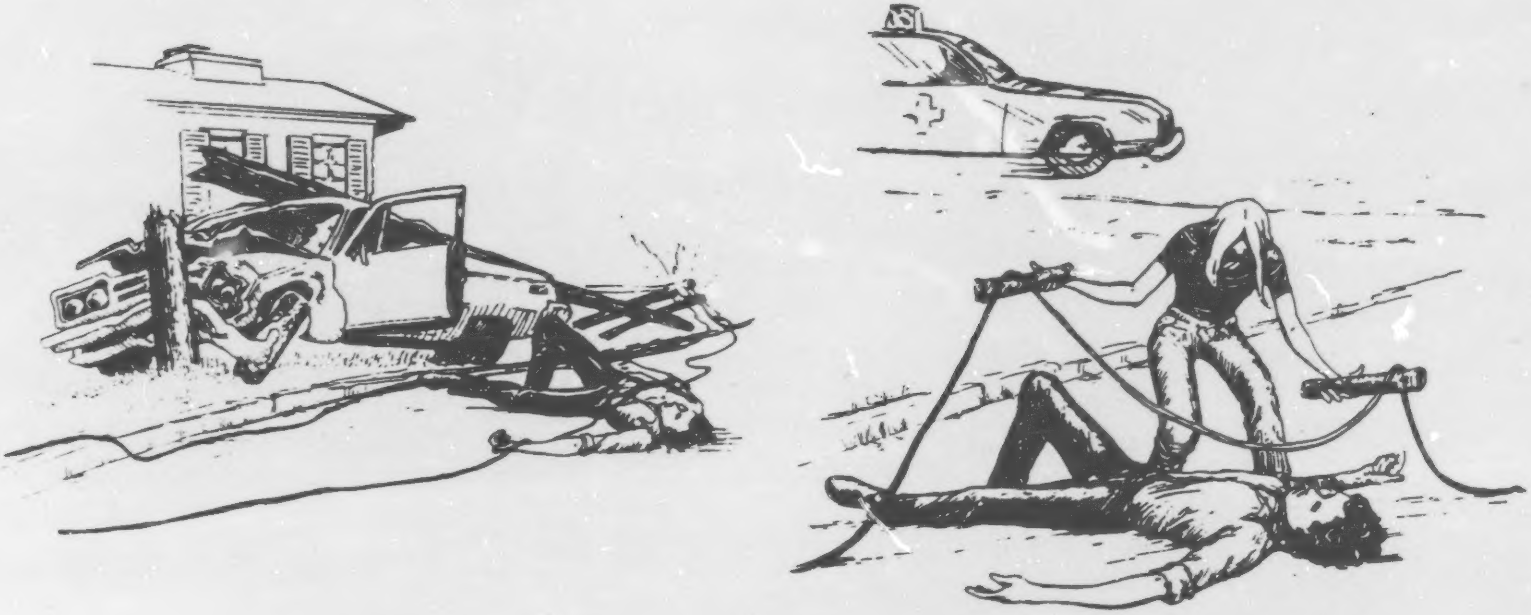


MISUSE

USE THE CORRECT TOOL FOR THE JOB! In this case, an insulated screwdriver--NOT A POCKETKNIFE!

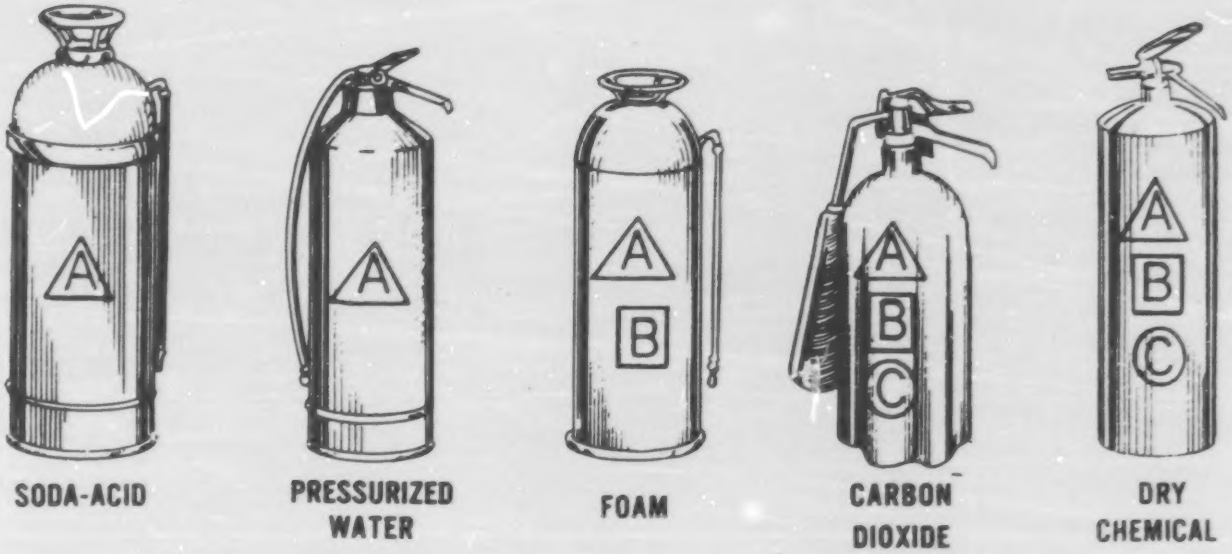


ELECTRICAL SHOCK VICTIMS



USE A NON-CONDUCTOR (NEWSPAPER, STICK, RUBBER HOSE) TO REMOVE A LIVE WIRE FROM A PERSON. Be sure that whatever you use is dry! A green tree limb contains moisture. Be careful what you use.

TYPES OF FIRE EXTINGUISHERS


A
A
A
B
A
B
C
A
B
C
SODA-ACID
PRESSURIZED WATER
FOAM
CARBON DIOXIDE
DRY CHEMICAL

A **CLASS A** - Fires that occur in ordinary combustible materials, such as wood, rags, and rubbish.

B **CLASS B** - Fires that occur with flammable liquids, such as gasoline, oil, paints, and thinners.

C **CLASS C** - Fires that occur in or near electrical equipment such as motors, switchboards, and electrical wiring.

INFORMATION SHEET 3--ELECTRICAL TOOLS AND MATERIALS

I. Terms and Definitions

A. Conduit--metal or plastic pipe used to protect electric wires

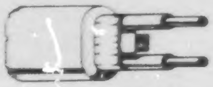
B. Outlet--place in the wiring where appliances may be attached to the receptacle

C. Receptacle--device installed at the outlet to connect the appliance with electricity

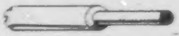
D. Duplex--double receptacle

II. Types of Wire Conductors

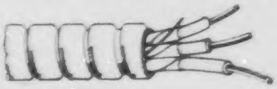
A. Nonmetallic cable (NM)



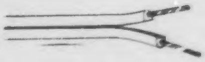
B. Thermal wire cable (TW)



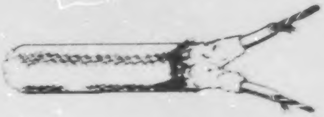
C. Metallic armored cable (BX)



D. Lamp cord (rubber or braided insulation)



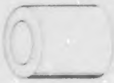
E. Power service cord (SJ)



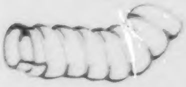
III. Types of Conduit

A. Thinwall (EMT) Electrical Metallic Tubing

B. Rigid

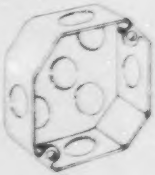


C. Flexible

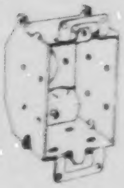


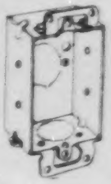
IV. Types of Electrical Boxes (made of plastic or metal)--used for splicing non-metallic cable as in junction boxes and for attaching switches, receptacles, and light fixtures

A. Octagonal ceiling or junction



B. Rectangular wall switch or outlet





C. Shallow

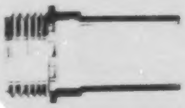
D. Special

1. Waterproof

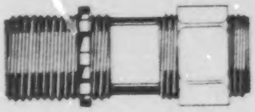
2. Shallow

V. Types of Electrical Connectors

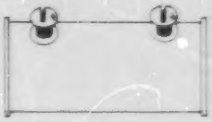
A. Conduit connectors



1. Indenter type

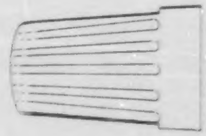


2. Compression type



3. Coupler

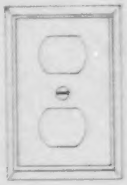
B. Conductor connectors



1. Wire nuts

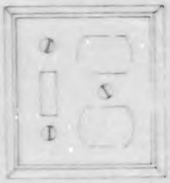
2. Soldered and taped

VI. Types of Electrical Covers--Plastic or Metal--used to safety cover switch and receptacle connections



A. Duplex receptacle

B. Toggle switch

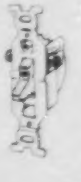


C. Combination duplex and switch

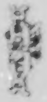
D. Specialty

VII. Types of Switches--used to open and close circuits

A. Single pole

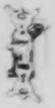


B. Three-way



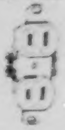
C. Mechanical quiet

D. Mercury

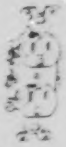


VIII. Types of Outlets and Receptacles

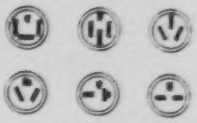
A. Duplex without ground



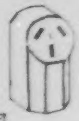
B. Duplex with ground



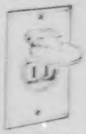
C. 208-240V



D. Surface mount 240V



E. Weatherproof



IX. Types of Electrical Safety Devices

A. Fuses

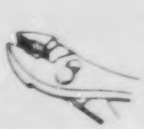
1. Plug
2. Blade
3. Cartridge
4. Type S
5. Time delay

B. Circuit breaker

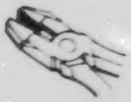
X. Tools Used in Electrical Wiring

A. Pliers

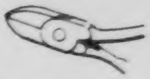
1. Slip joint



2. Lineman

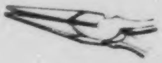


3. Diagonal cutter

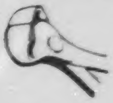


(NOTE: Often called "dikes")

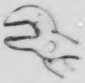
4. Long nose



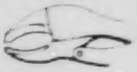
5. End cutter



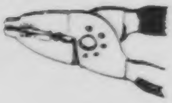
6. Channellock



7. Vice-grip

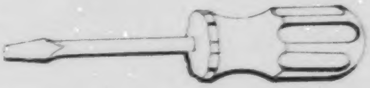


8. Wire stripper

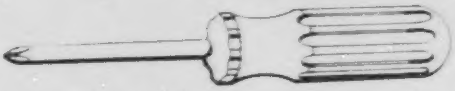


B. Screwdrivers

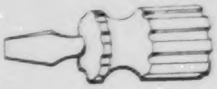
1. Straight slot



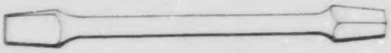
2. Phillips point



3. Stubby



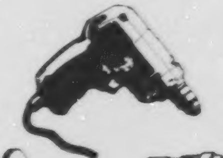
4. Screwdriver bit



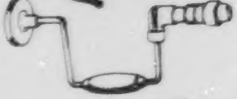
C. Drills and bits

1. Drills

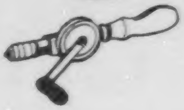
   a. Power



   b. Bit brace

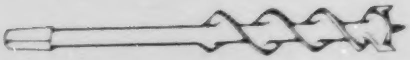


   c. Hand drill

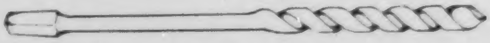


2. Bits

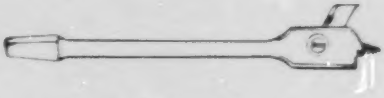
   a. Auger



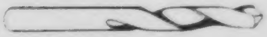
   b. Wood twist



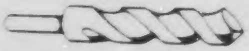
   c. Expansive



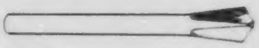
   d. Twist drill



   e. Masonry

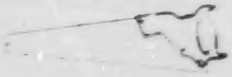


   f. Star drill

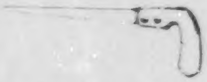


D. Types of saws

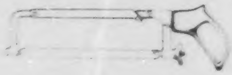
   1. Crosscut hand



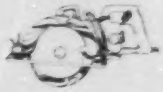
   2. Keyhole



   3. Hack

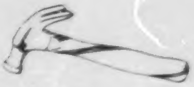


   4. Power hand or circular

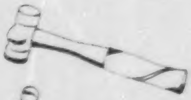


E. Hammers

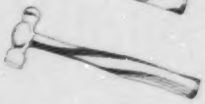
   1. Claw



   2. Lineman

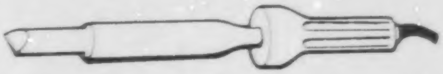


   3. Ball peen

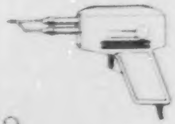


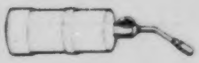
F. Soldering equipment

   1. Soldering iron



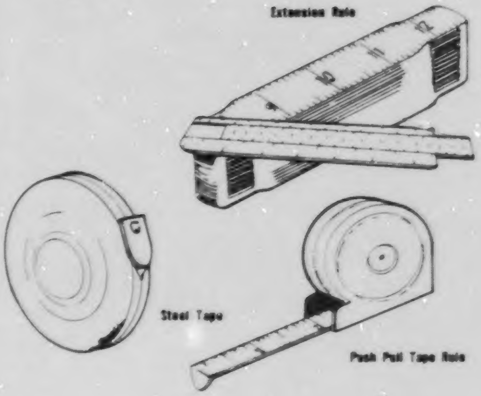
   2. Soldering gun



3. Propane torch 
4. Solder
5. Soldering paste

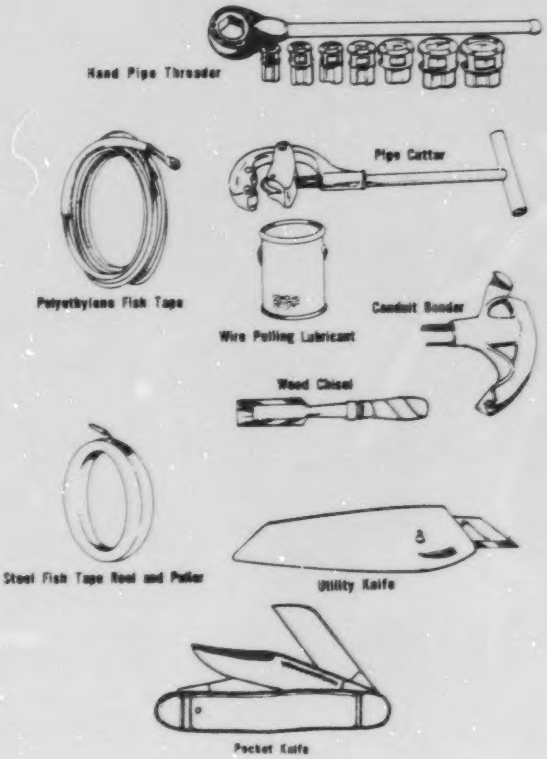
G. Measuring devices

1. 6- to 12-foot push-pull tape
2. 50- to 100-foot steel tape
3. Folding rule


Extension Rule
Steel Tape
Push Pull Tape Rule

H. Special tools and equipment

1. Equipment for wire pulling
    a. Steel fish tape
    b. Polyethylene fish tape
    c. Wire pulling lubricant
2. Cutting and bending tools
    a. Pipe cutter
    b. Pipe threader
    c. Conduit bender
    d. Wood chisel
    e. Utility knife
    f. Pocket knife


Hand Pipe Threader
Pipe Cutter
Polyethylene Fish Tape
Wire Pulling Lubricant
Conduit Bender
Wood Chisel
Steel Fish Tape Reel and Puller
Utility Knife
Pocket Knife

3. The volt-ohm meter and other testing tools

   a. Volt--a unit for measuring the force of an electric current

   b. OHM--a unit for measuring electrical resistance

   c. Volt-ohm meter--a simple electrical measuring instrument used to troubleshoot electrical problems

   d. VAC--volts alternating current

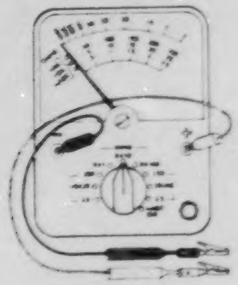
   e. VDC--volts direct current

   f. MADC--milliamps direct current

   g. Ohms scale--low ohms readings are at right, high at left on the Volt-ohm meter

   h. ∞ --symbol meaning infinity (number without beginning or end)

4. The Volt-ohm meter



   a. Ohms scale--Has low ohms readings at right, high at left--the opposite of other scales. Multiply ohms reading by whatever number selector switch shows (R X 10 or R X 100). Symbol at left (∞) stands for infinity. When needle points to this symbol, ohms reading is higher than meter can measure.

   b. VAC, VDC, and MADC scales--Read here for volts AC, volts DC, or milliamps DC (thousandths of an ampere). Switch shows which set of numbers to use: top, middle, or bottom. When measuring unknown voltages, start with selector on the highest scale (25) and work down to get increased sensitivity and correctness.

   c. Selector switch--Move switch so that it points to what you want to measure. Instead of selector switch, some low-priced meters have many jacks, each one matching a different measurement.

d. Test leads and jacks--Always insert black lead in - jack, red lead in + jack (--jack is also called com or common). When testing a battery or other DC voltage source, put the black probe to negative terminal, red probe to positive terminal.

e. Pointer adjustment--Take both probes from their jacks and check position of needle. It should point to zero volts. If it does not, turn pointer adjustment screw so that it does. If needle cannot be moved, meter is broken and should be sent to factory to be fixed.

f. Ohms adjustment knob--Each time you turn the selector to an ohms position from another position, you must "zero-adjust" the ohms scale. Plug test leads into their jacks, hold or clip their probe ends firmly together, and turn Ω ADJ knob until needle reads zero ohms. Greek letter Omega (Ω) is the symbol for ohms.

g. Test probes--In order to get correct readings on the volt-ohm meter, both probes must make firm electrical contact at the test points. Alligator type probes usually do this best; they also free your hands for moving parts during test. Needle-type probes may be needed to get into tight spots or make contact with very small terminals. You can get alligator probes that slip over needle probes, or use two pairs of test leads--one with alligator probes, the other with needle probes.

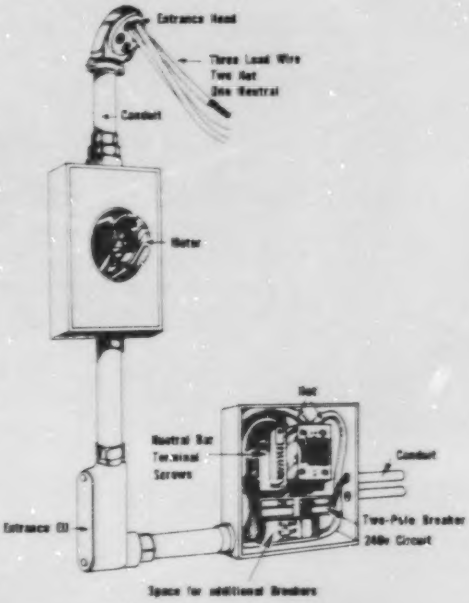
5. Other testing devices

a. Neon tester--finds the presence of voltage between 90 and 550 volts in a circuit

b. Continuity tester--has a battery inside to test if a circuit is unbroken. It cannot be used on live circuits or used instead of the neon tester.

XI. Parts of an Electrical Entrance

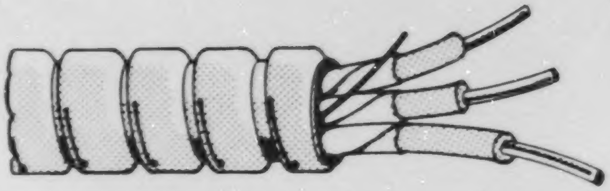
A. Lead wires
B. Entrance lead
C. Meter box
D. Entrance ell
E. Neutral bar
F. Single pole breaker
G. Two pole breaker
H. Main breaker
I. Panel



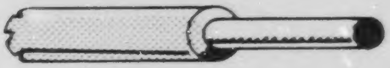
ASSIGNMENT SHEET 6--IDENTIFY ELECTRICAL CONDUCTORS

Directions: Identify each type of conductor pictured below. Write the name of each listed below in the correct blank.

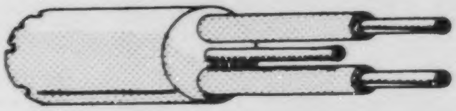
Non-metallic cable with ground
Lamp cord-braided
Power service cord-3 wire
Metallic armored cable
Lamp cord (rubber covered)
Thermal wire cable



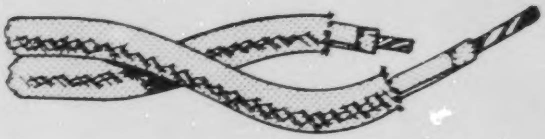
A. ______________________



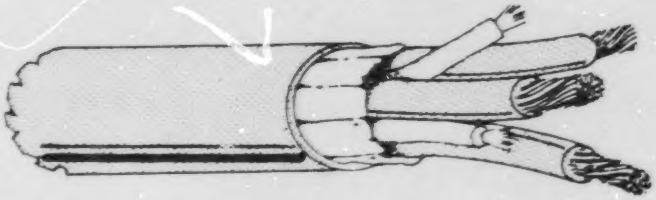
B. ______________________



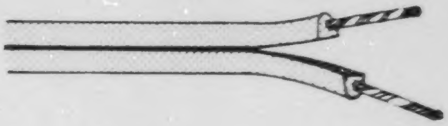
C. ______________________



D. ______________________



E. ______________________



F. ______________________

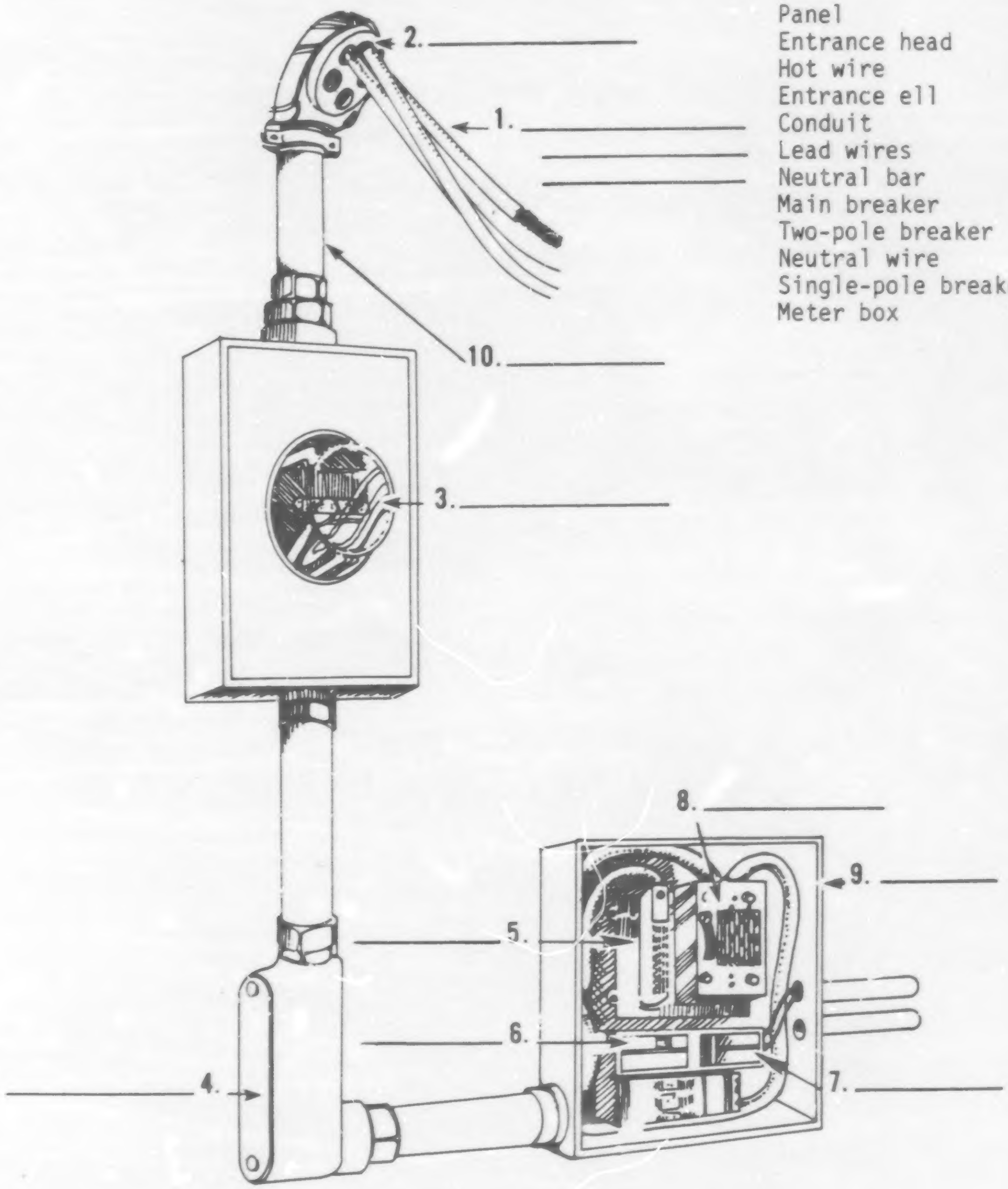
ASSIGNMENT SHEET 7--IDENTIFY ELECTRICAL TOOLS

Directions: Your instructor will make a display of each tool listed in Part X of the Information Sheet. Each tool will be assigned a number only. On a sheet of paper, write the correct name of each tool beside the number of that tool.

ASSIGNMENT SHEET 8--IDENTIFY ELECTRICAL SERVICE ENTRANCE PARTS

Directions: Using the picture below and the Information Sheet, identify ten major parts of an electrical service entrance by writing the answer in the space provided.

Panel
Entrance head
Hot wire
Entrance ell
Conduit
Lead wires
Neutral bar
Main breaker
Two-pole breaker
Neutral wire
Single-pole breaker
Meter box



ASSIGNMENT SHEET 9--LIST THE PARTS OF A VOLT-OHM METER

Directions: Using the list below, identify the parts of a volt-ohm meter.

VAC, VDC, and MADC scales

Test leads and jacks

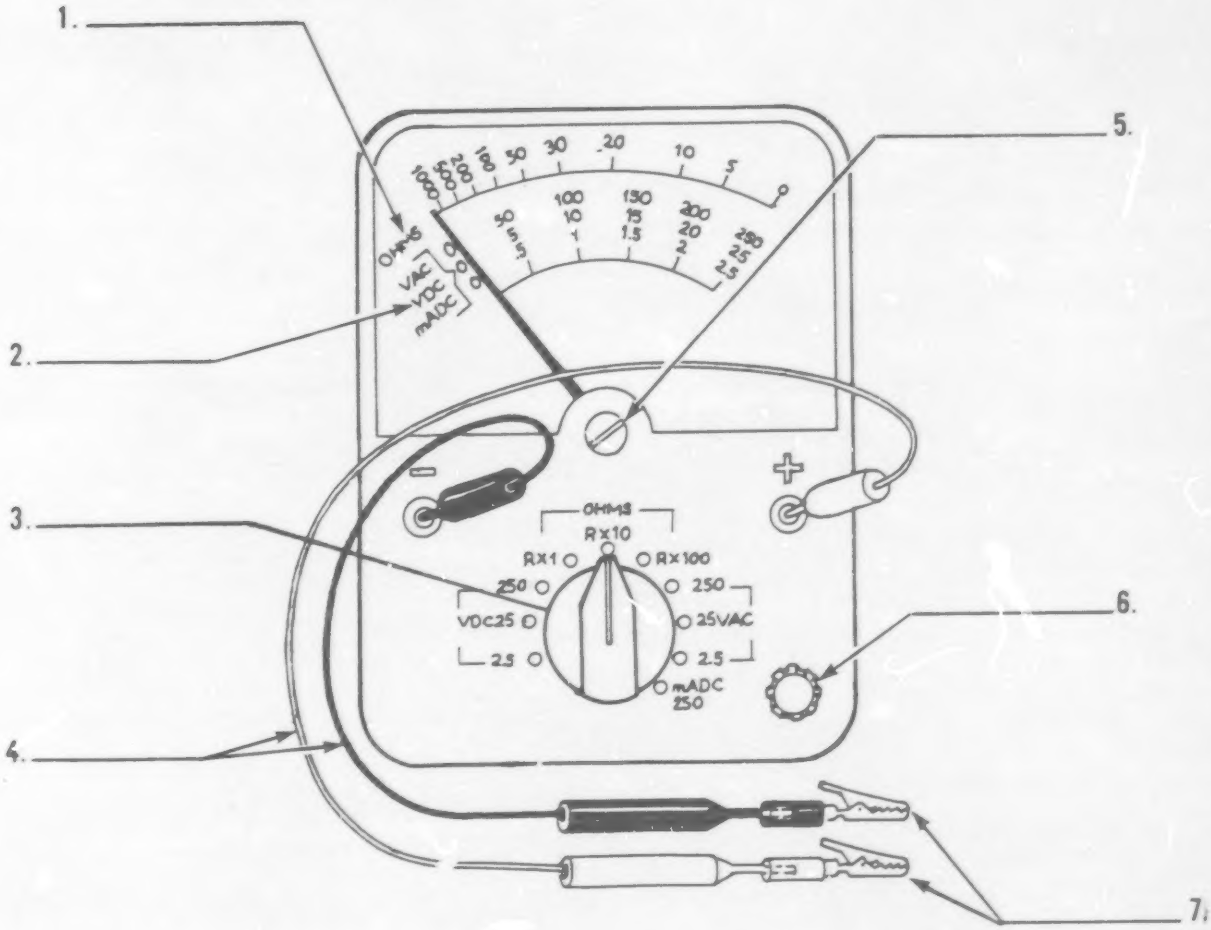
Selector switch

Test probes

Ohms adjustment knob

Pointer adjustment

Ohms scale


1.
2.
3.
4.
5.
6.
7.
OHMS
VAC
VDC
mADC
1000
500
200
100
50
30
20
10
5
0
50
5
.5
100
10
1
150
15
1.5
200
20
2
250
25
2.5
−
+
OHMS
R×10
R×1
R×100
250
VDC25
2.5
250
25VAC
2.5
mADC
250

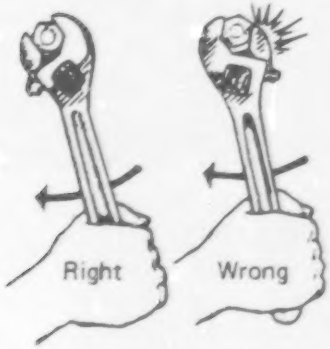
INFORMATION SHEET 4--USING HAND TOOLS

I. Terms and Definitions

- A. Straightedge--a straight strip of wood or metal used with a level or for marking straight lines
- B. Perpendicular--at a 90° angle to a surface
- C. Planing--trimming and fitting wood with a sharp-edged tool
- D. Drilling--making a hole with a drill
- E. Boring--making a hole larger than 1/4 inch with an expansion bit
- F. Honing--removing the wire edge from sharpened blades with an oilstone
- G. Bevel--the ground or angled surface on a chisel or plane iron
- H. Set--the staggering of teeth on a saw so that the body of the saw does not bind
- I. Kerf--the width of the slot the saw leaves in the wood
- J. Convex--an outward rounded or bell-faced surface
- K. Wedges--small pieces of metal driven into the head of a hammer to keep it in place
- L. Plumb--a straight up and down or vertical position

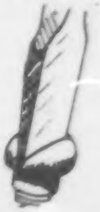
II. Tool Safety and Care

- A. Use tools correctly.

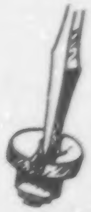


B. Keep tools working properly.

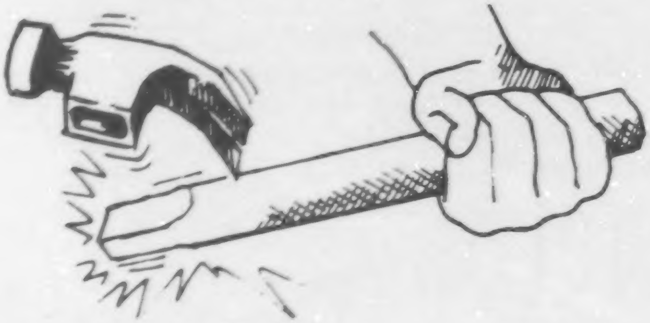
1. A correct screwdriver fit



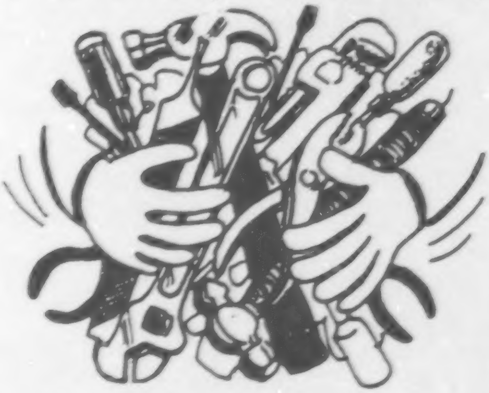
2. A poor fit damages the screwdriver and screw slot.



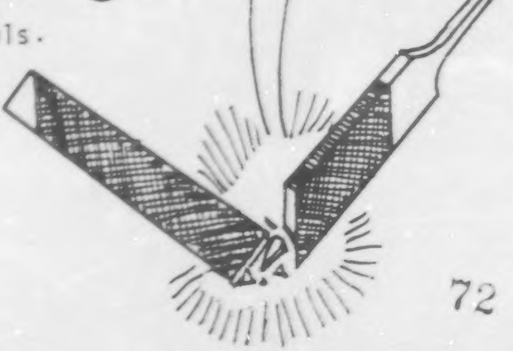
C. Check hammer heads before use.



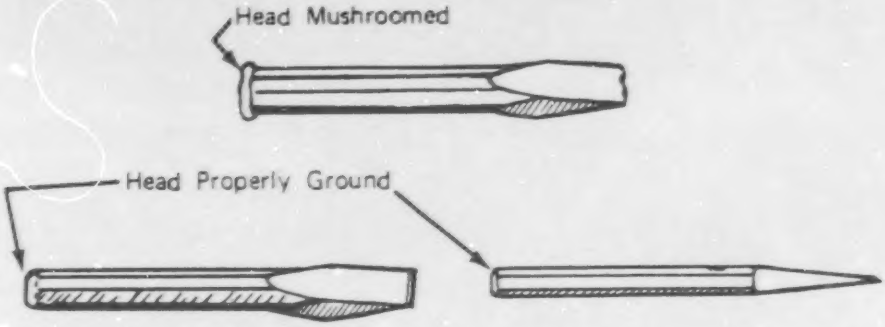
D. Do not carry more tools than you can handle.



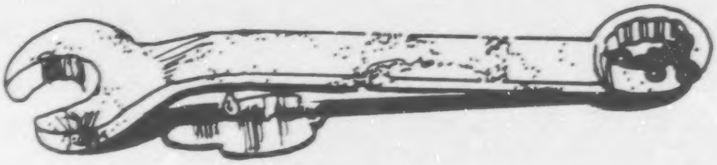
E. Do not drop tools.



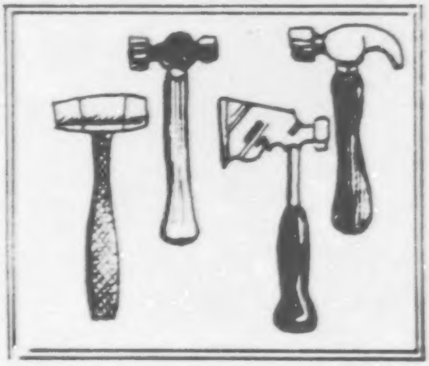
F. Keep sharpened tools sharp.


Head Mushroomed
Head Properly Ground

G. Keep tools clean and dry.



H. Return tools to their storage area after use.



ASSIGNMENT SHEET 10--USING HAND TOOLS

A. Write a short definition for each of the following words.

1. Straightedge

2. Perpendicular

3. Planing

4. Drilling

5. Boring

6. Honing

7. Bevel

8. Set

9. Kerf

10. Convex

11. Wedges

12. Plumb

B. List eight rules of safety for using hand tools.

1.
2.
3.
4.
5.
6.
7.
8.

INFORMATION SHEET 5--USING POWER TOOLS

I. Terms and Definitions

A. Maintenance--the care and upkeep of equipment

B. Feed--the speed at which the blade, bit, or cutter of a power tool is moved into the material

C. Portable--light and easily movable tools that are usually hand-held while being used

D. Receptacle--the power source for a power tool

E. RPM--the number of turns in a minute of a blade, bit, or cutter in a power tool

F. Margin of safety--keeping hands a certain distance away from the blade, bit, or cutter at all times

II. General Power Tool Safety

A. Be familiar with how to use each machine before you use it.

B. Be alert when using power tools.

C. Make all adjustments with power tools turned off.

D. Do not allow others to distract you.

E. Keep any safety guards or covers in place.

F. Wear safety glasses when using or when around power tools.

G. Be sure machines, receptacles, and plugs are properly grounded.

H. Develop a good safety attitude.

I. Know the types of safety zones and do not break any of them.

J. Have permission from your employer or instructor before using power tools.

K. Do needed maintenance on power tools before using.

III. Parts of Portable Circular Saw

A. Handle

B. Switch

C. Motor

D. Upper guard

E. Telescoping guard

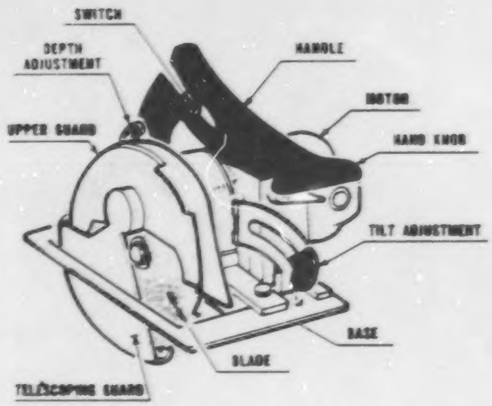
F. Hand knob

G. Tilt adjustment

H. Base

I. Depth adjustment

J. Blade


SWITCH
DEPTH ADJUSTMENT
HANDLE
MOTOR
UPPER GUARD
HAND KNOB
TILT ADJUSTMENT
BASE
BLADE
TELESCOPING GUARD

IV. Safety for the Portable Circular Saw

A. Do not change blades with the cord plugged in.

B. Use the right blade and be sure it is sharp.

C. Be sure the work is supported correctly.

D. Do not force the saw into the work.

E. Adjust the depth of cut so that the teeth of the blade will clear the depth of the material about 1/8 inch.

F. Use both hands when sawing.

G. Be careful not to cut into the sawhorse or other clamping device.

V. Parts of a Saber Saw

A. Switch

B. Guide knob

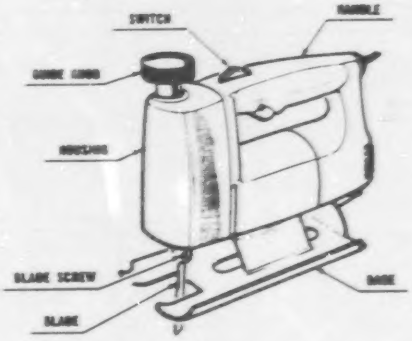
C. Housing

D. Blade screw

E. Blade

F. Base

G. Handle


SWITCH
HANDLE
GUIDE KNOB
HOUSING
BLADE SCREW
BASE
BLADE

VI. Safety for the Saber Saw

A. Select the right blade for your work and saw.

B. Do not cut curves so sharp that the blade will be twisted.

C. Make sure the work is well supported.

D. Do not saw into the sawhorse or other supports.

E. Turn on the motor before the blade touches the work.

F. Unplug the saw before making adjustments.

G. Make sure at least two teeth will touch the material being cut at all times.

H. Make sure the blade will saw completely through the material.

I. Keep a light downward pressure on the saw.

J. Turn the saw off and allow the blade to stop before taking the blade from a cut.

K. Tade off the blade before storing the saw.

VII. Parts of a Portable Drill

A. Housing

B. Geared key chuck

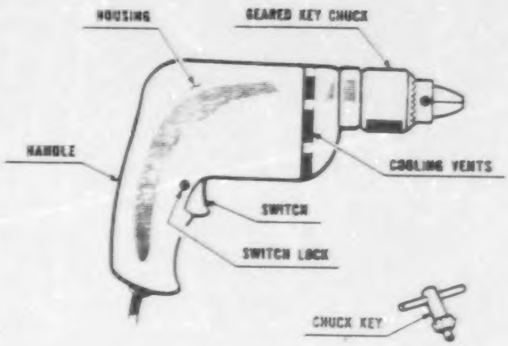
C. Switch

D. Switch lock

E. Chuck wrench

F. Cooling vents

G. Handle



VIII. Safety for the Power Drill

A. Use the right drill bit.

B. Mount the drill bit firmly.

C. Do not hammer on the chuck key.

D. Make sure the drill bit runs true.

E. Mount work firmly so it will not turn.

F. Make sure the drill will provide the correct RPM for the size of drill bit being used.

(NOTE: Smaller drill bits require more RPM than larger drill bits.)

G. Hold the drill firmly with both hands.

H. Keep the drill aligned with the hole while drilling.

I. Pull out the drill several times when drilling a deep hole.

(NOTE: This allows the cuttings to clear and prevents binding.)

ASSIGNMENT SHEET II--USING POWER TOOLS

A. Write a short definition for each of the following words:

1. Maintenance

2. Feed

3. Portable

4. Receptacle

5. RPM

6. Margin of safety

B. List five power tool safety rules.

1.

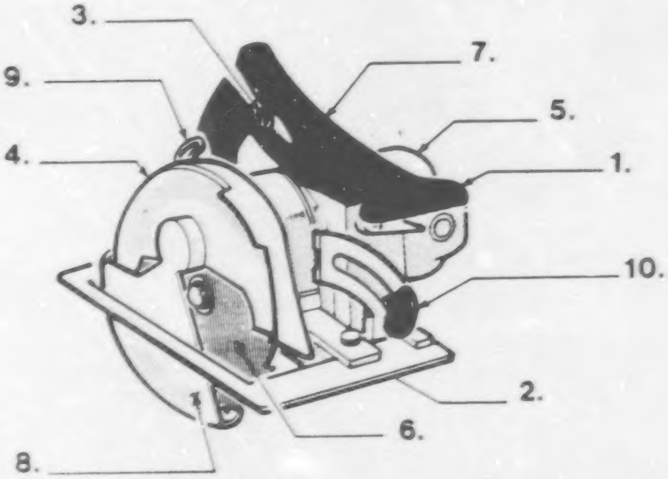
2.

3.

4.

5.

C. Label the parts of a circular saw



D. List five rules of safety for the circular saw.

1.

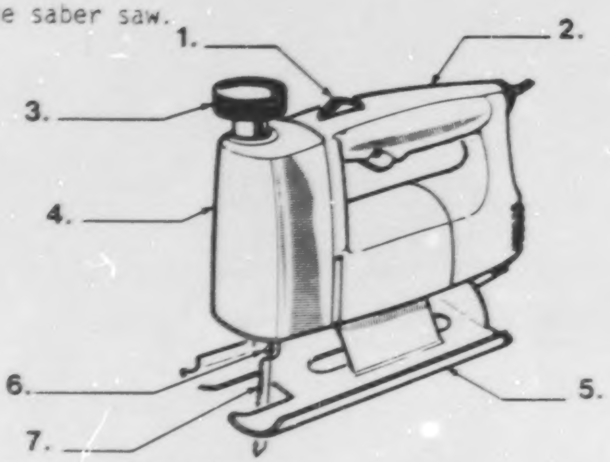
2.

3.

4.

5.

E. Label the parts of the saber saw.



F. List five rules of safety for the saber saw.

1.

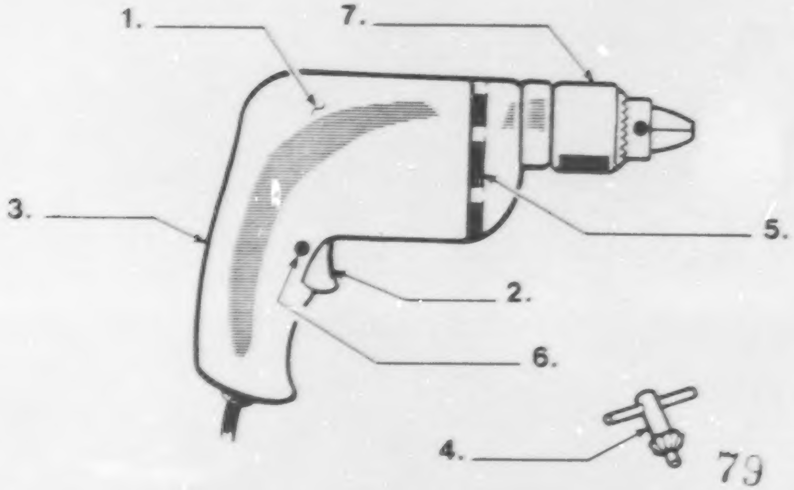
2.

3.

4.

5.

G. Label the parts of a portable drill.



H. List five rules of safety for the portable drill.

1.

2.

3.

4.

5.

INFORMATION SHEET 6--USING SOLDERLESS CONNECTORS AND MAKING SPLICES

I. Solderless Connectors

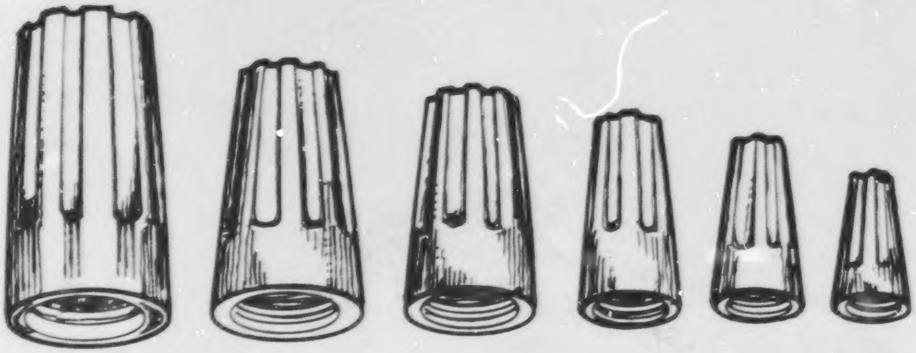
  A. Made to hold several electrical wires firmly together without using solder (metals that are melted and used to join or patch metal parts.)

  B. Used often because they are easy to use and they save time

  C. Most common types are plastic end caps or wire nuts

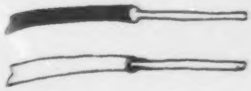
    1. Come in several sizes.

    2. Size found by the number and the size of the wire to be joined.

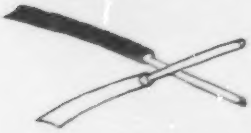


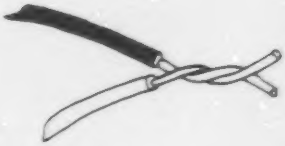
D. Steps for using end caps.

  1. Strip ends of each wire at least 3/4 inch.

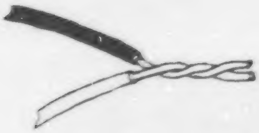


  2. Twist wires together.

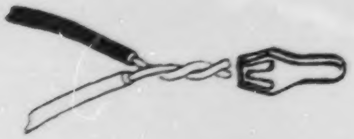




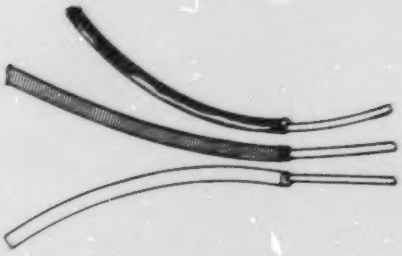
  3. Cut off projecting ends.

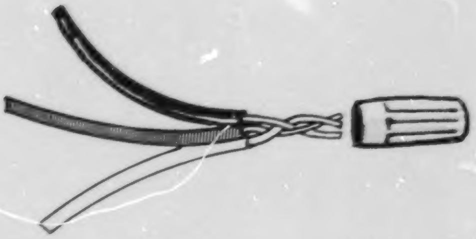


4. Screw on the plastic endcap.

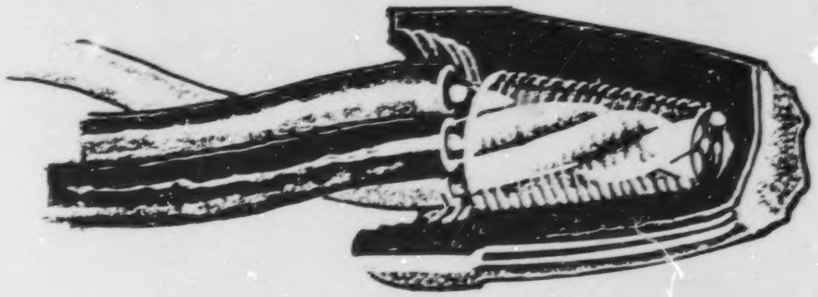


5. When using more than two wires, the same steps are used except with larger end caps.





6. Inside view:

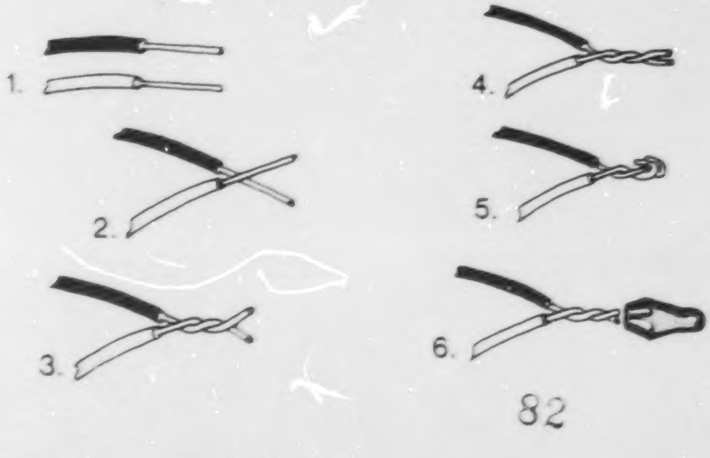


II. Splices (See IS-9)

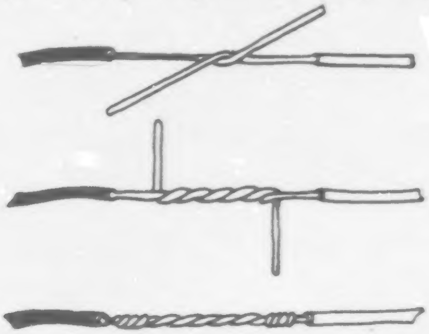
(NOTE: A splice is the joining of two or more electrical conductors by twisting them together or by using a splicing device as an endcap.)

A. Types of splices

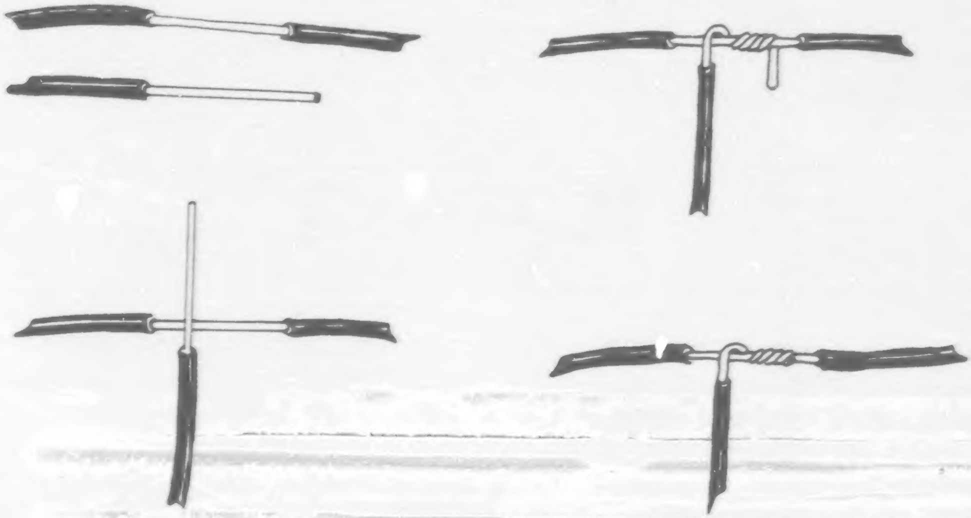
1. A pigtail splice is a simple, most commly used splice.



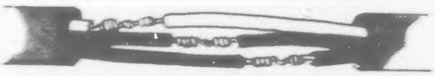
2. The western union splice is used when connection must be strong enough to support long lengths of heavy wire.

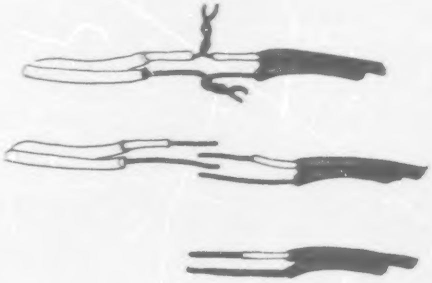


3. A t-tap slice allows connection to be made without cutting the main line.

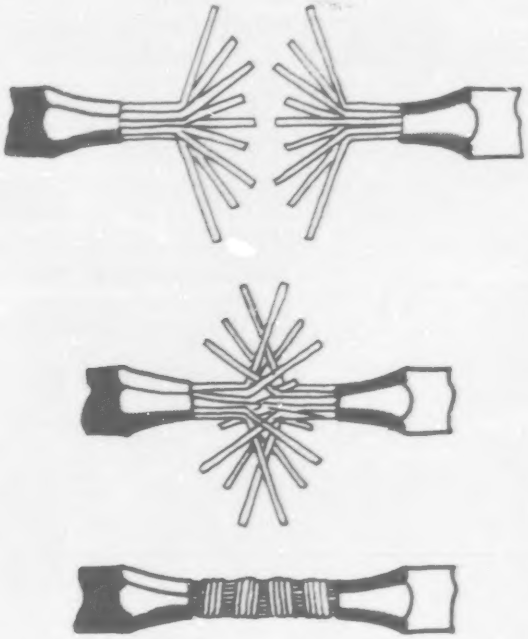


4. Portable cord splices are very weak splices because there is no connector to hold them together. They should be used only in an emergency. Each wire must be taped separately. The splices should be staggered to prevent a large bump when the outer tape is put on.





5. Cable splices are used for large stranded cables such as car cables (battery) and welding cables.



B. Taping splices (See IS-10)

1. Taping protects the splice from rust and insulates against electrical shock.

2. Taping should provide as much insulation to the splice as the original covering.

3. One wrap of plastic-vinyl tape will provide insulation protection up to 600 volts, but several wraps are needed.

4. When plastic-vinyl tape is used, it should be stretched as it is put on. Stretching will hold the tape more firmly.

ASSIGNMENT SHEET 12--USING SOLDERLESS CONNECTORS AND MAKING SPLICES

A. What are solderless connectors and why are they used?

B. How is the size of solderless connectors (endcaps) found?

C. List the four steps in using end caps.

1.

2.

3.

4.

D. List four types of splices and tell how they are used.

1.

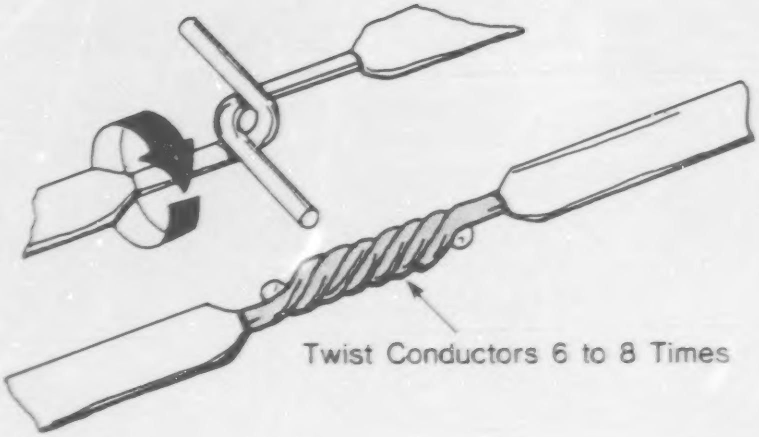
2.

3.

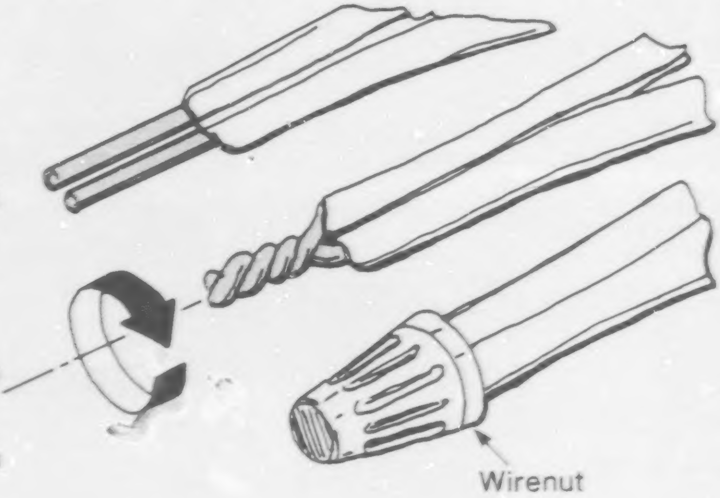
4.

JOINING WIRES

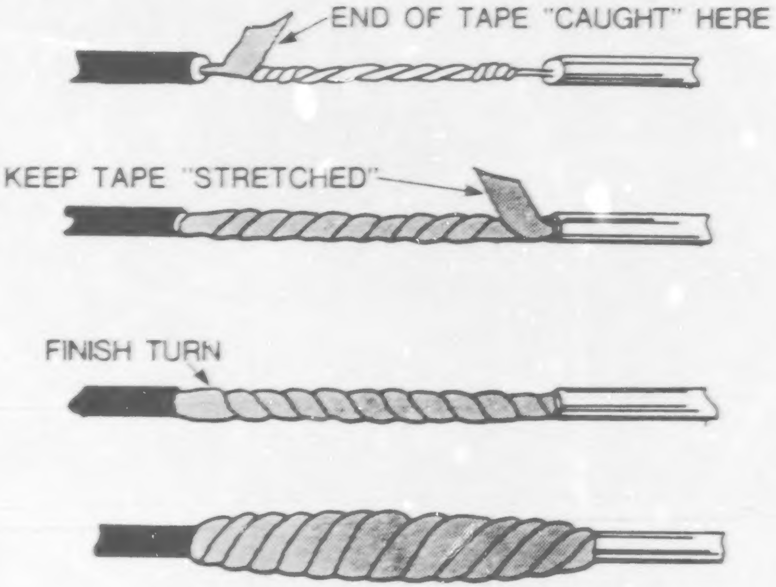
One way to form a wire joint is to twist the ends of conductors together six to eight times. The joint can then be soldered and wrapped with electrical tape.



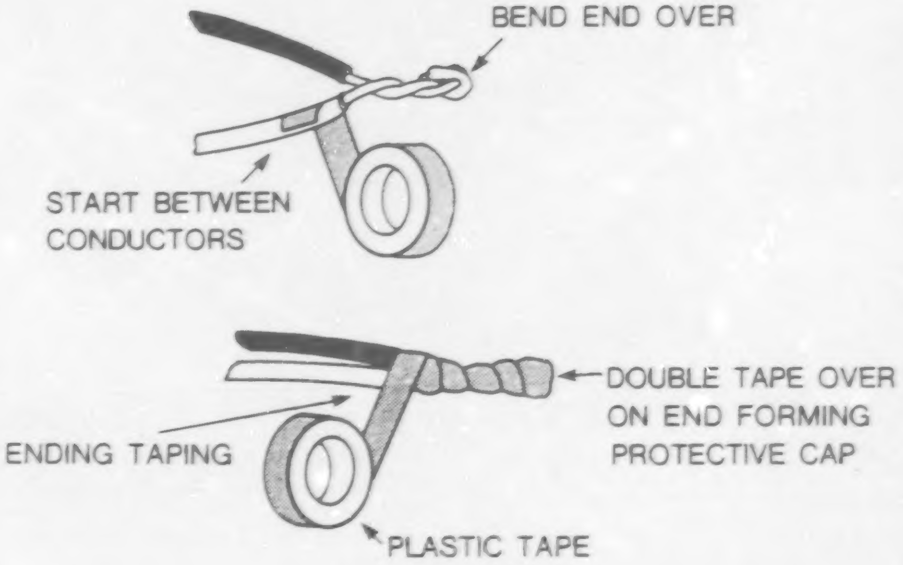
One of the most popular ways to join wires is to use solderless connectors called wirenuts. The conductor ends are twisted together and the wirenut is screwed onto the twisted ends. Make sure, however, that the conductor's insulation goes all the way up to the wirenut and that no bare conductor is exposed.



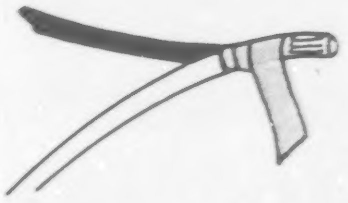
TAPING SPLICES


END OF TAPE "CAUGHT" HERE
KEEP TAPE "STRETCHED"
FINISH TURN

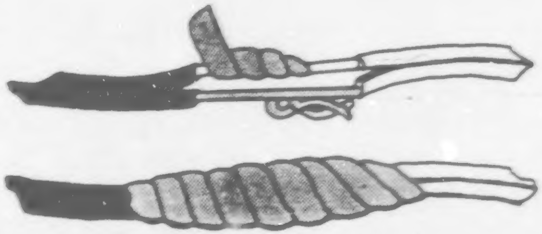
Technique for taping a Western Union splice.


BEND END OVER
START BETWEEN CONDUCTORS
DOUBLE TAPE OVER ON END FORMING PROTECTIVE CAP
ENDING TAPING
PLASTIC TAPE

Technique for taping a pigtail splice.



Technique for taping a solderless connector.

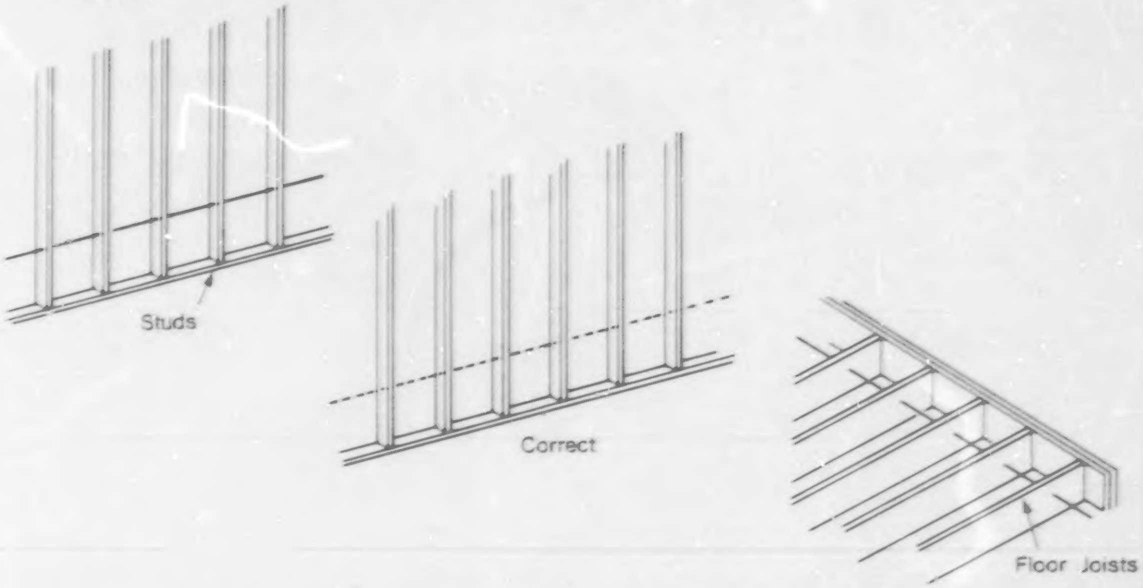


Technique for taping cord splice in an emergency only.

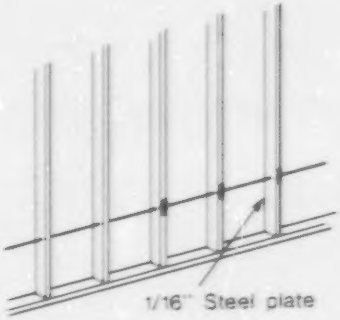
INFORMATION SHEET 7--PULLING CABLE

I. Installing Cable Runs

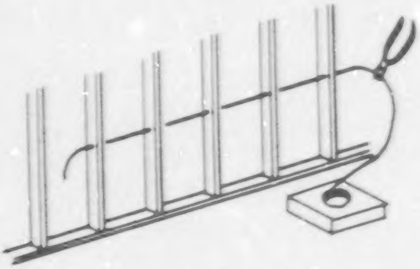
A. Holes should be drilled as straight as possible in studs to aid in pulling wires. The holes should also be drilled in the center of the studs to provide protection for the cable. The same applies to floor joists as well.



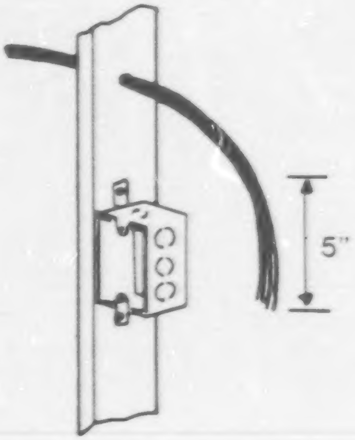
B. In some cases, studs or floor joists may have to be notched instead of drilled. When studs or floor joists are notched, a steel plate at least 1/16-inch thick must be used to cover the notch.



C. Cable should be pulled to where it should be and then cut to the right length. This helps avoid waste.

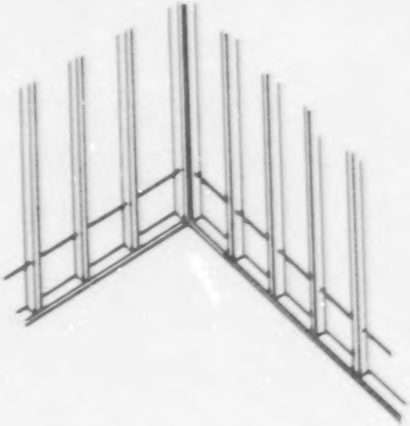


D. Cable insulation should be removed before being installed into box.

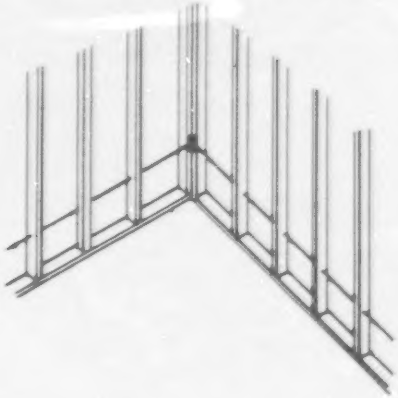


II. Methods of Routing Cable Around Corners

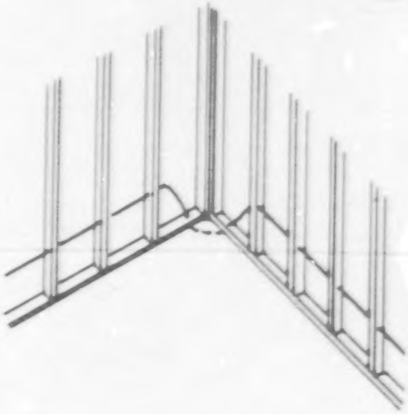
A. Drill holes from each side at an angle. This method will save wire, but takes much time if holes do not match.



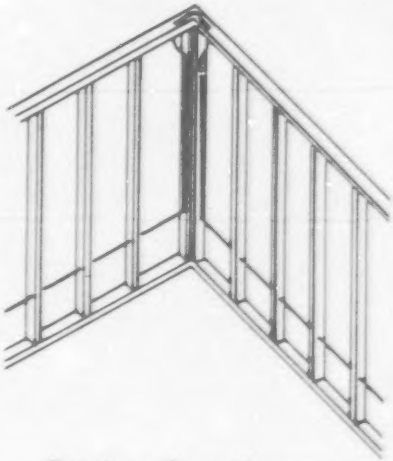
B. Notch the corner studs; however, notching requires a steel plate for protection.



C. Routing over or under the corner. The under-corner method takes the most time and usually takes two people. The over-corner method is the quickest, but uses more cable.



Routing under corner



Routing Over Corner

ASSIGNMENT SHEET 13--PULLING CABLE

A. How should holes be drilled in studs and floor joists prior to running cable?

B. When studs of floor joists are notched, what must be done?

C. List four ways of routing cable around corners.

1.

2.

3.

4.

D. Why should cable be pulled to its proper place and then cut for length?

INFORMATION SHEET 8--BOX IDENTIFICATION AND INSTALLATION

I. Electrical Boxes

- A. Metal
- B. Plastic
- C. Fiber
- D. Nylon
- E. Rubber

II. Types of Boxes (See IS 11 and 12)

- A. Handy (used for splices)
- B. Switch (used for switches and receptacles)
- C. Octagon (used mainly for lighting)
- D. Square (used with covers designed for special purposes, such as switch-receptacle combination)

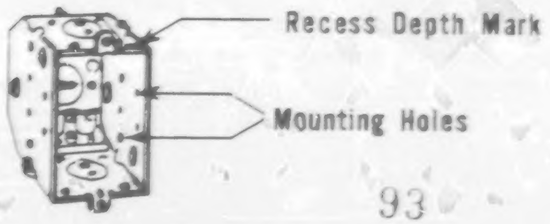
III. General Information

- A. Must be installed at every point where cab[illegible] will be spliced or cut off.
- B. Usually secured by nails driven throug[illegible]ck of box or through straps.
- C. Straps may be mounted on the side or front of box, depending on where box is located.
- D. Bar hangers are often used in ceilings.
- E. Boxes can be bought with threaded holes for grounding screws, or with screws with pigtails or with grounding clips.

IV. Installation of Box

- A. Find where outlet box should go.
- B. Find box mounting holes and recess depth mark on box.

  (NOTE: Recess depth mark is a slight indention about 1/4 inch from box opening.)

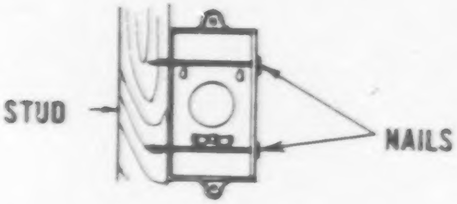


C. Decide which nail holes to use.

D. Hold box in desired position, with recess depth mark even with edge of stud.

E. Drive nails through holes into stud until nails are snug against box.

F. Check box to be sure it is held tightly in place.



ELECTRICIAN'S HELPER

ASSIGNMENT SHEET 14--BOX IDENTIFICATION AND INSTALLATION

A. List four things electrical boxes are made of.

1.

2.

3.

4.

B. List the four types of boxes and their uses.

1.

2.

3.

4.

C. Answer the following statements true or false by placing a T for True or an F for False in the space at the left.

_____ 1. Boxes are usually secured by nails.

_____ 2. Bar hangers are used in ceilings.

_____ 3. Straps may not be mounted on the side of the box.

_____ 4. Boxes must not be installed at cable splices.

_____ 5. Boxes may be bought with threaded holes for grounding screws.

_____ 6. Straps may be mounted on the front of box.

_____ 7. Nails may be driven through back of box.

_____ 8. Boxes must be installed where cables are cut off.

_____ 9. Boxes may be bought with scres with pigtails for grounding.

_____10. Boxes may be purchased with grounding clips.

D. List the six steps for installing a box.

1.

2.

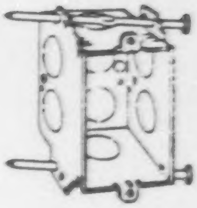
3.

4.

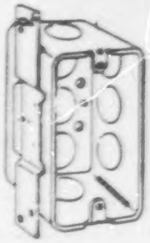
5.

6.

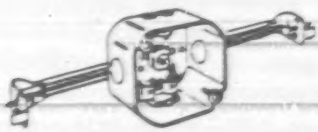
E. Identify the following boxes.



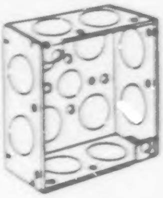
1. ______________________________



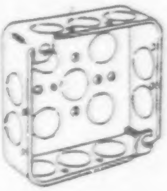
2. ______________________________



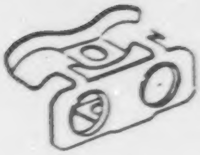
3. ______________________________



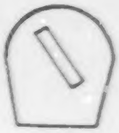
4. ______________________________



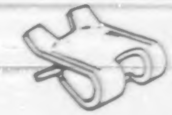
5. ______________________________



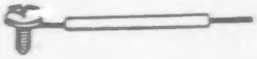
6. ______________________________



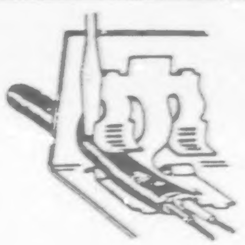
7. ______________________________



8. ______________________________



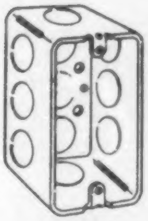
9. ______________________________



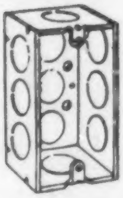
10. ______________________________

DEVICE BOXES

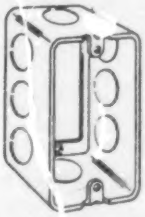
HANDY BOXES



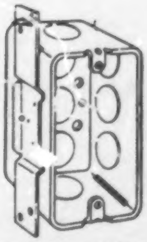
HANDY BOX
(MOLDED
CONSTRUCTION)



HANDY BOX
(WELDED
CONSTRUCTION)

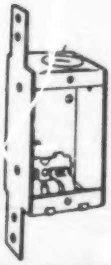


EXTENSION

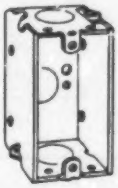


BRACKET BOX

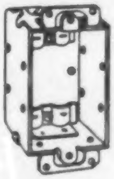
SWITCH BOXES



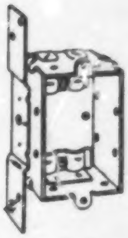
BRACKET
NON-GANGABLE
WITH
CABLE CLAMPS



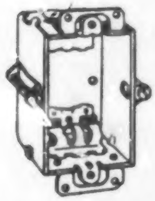
GANGABLE
WITH
NAIL HOLES



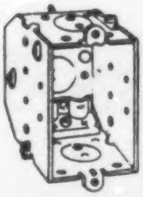
GANGABLE
WITH
EARS AND
CABLE CLAMPS



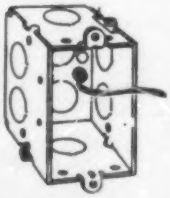
GANGABLE
BRACKET BOX
WITH
CABLE CLAMPS



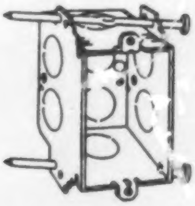
WITH
DRYWALL GRIPS,
CABLE CLAMPS
AND EARS



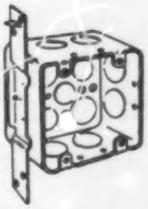
BEVELED
CORNER
WITH
CLAMPS



GANGABLE
WITH
GROUNDING
PIGTAIL



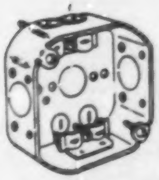
NAIL ON



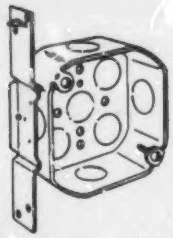
SOLID
TWO GANG
BRACKET

OCTAGON AND SQUARE BOXES

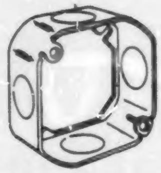
OCTAGON BOXES



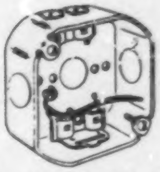
WITH CABLE CLAMPS
AND NAIL HOLES



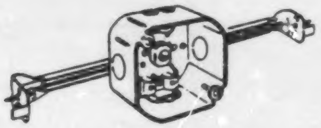
WITH BRACKET



EXTENSION

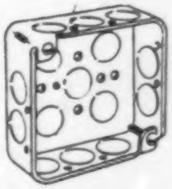


WITH CABLE CLAMPS
AND GROUNDING PIGTAIL

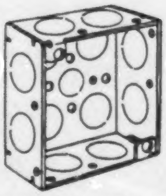


WITH BAR HANGER
AND CABLE CLAMPS

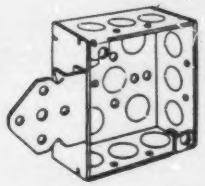
SQUARE BOXES



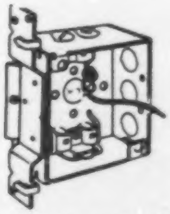
SQUARE BOX (ONE PIECE
MOLDED CONSTRUCTION)



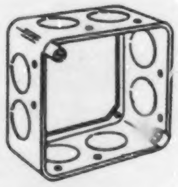
SQUARE BOX (ONE PIECE
WELDED CONSTRUCTION)



WITH BRACKET



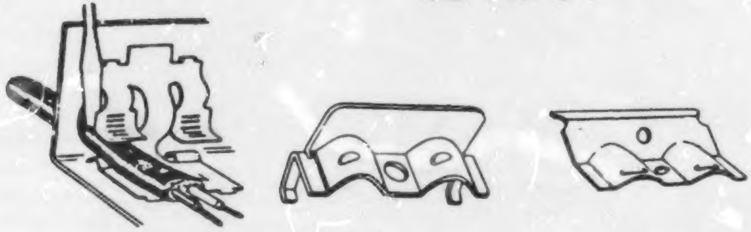
WITH BRACKET, CABLE CLAMPS
AND GROUNDING PIGTAIL



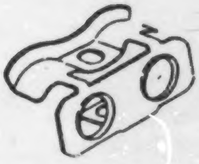
EXTENSION

BOX DESIGN FEATURES

CLAMPS

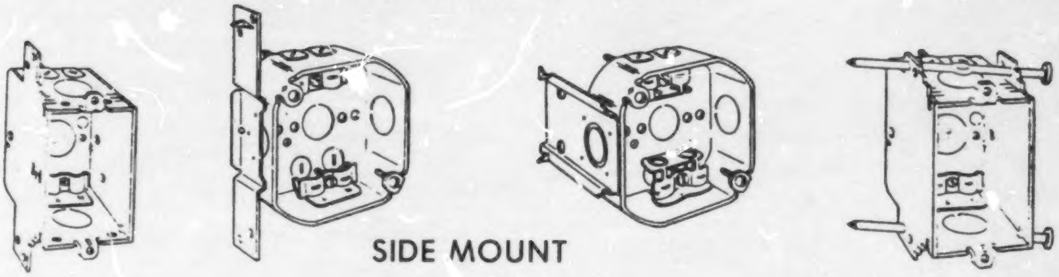


NONMETALLIC CABLE CLAMPS

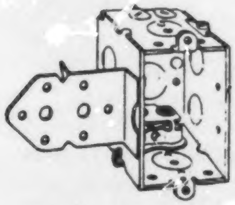


METALLIC CABLE CLAMP

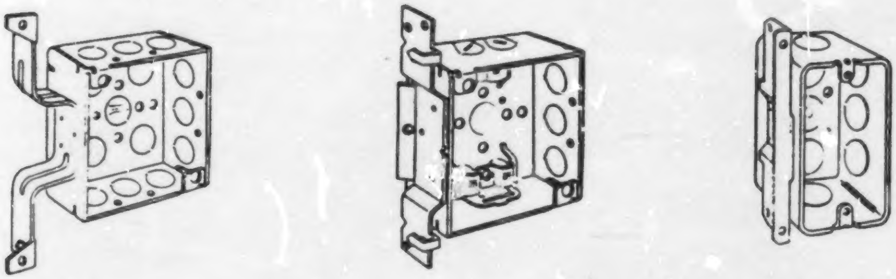
BRACKETS



SIDE MOUNT



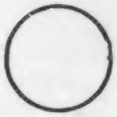
FRONT MOUNT

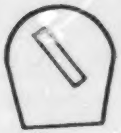


SIDE AND FRONT MOUNT

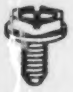
BOX DESIGN FEATURES (Continued)

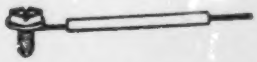
BOX OPENINGS

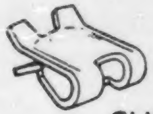

KNOCKOUT


PRI-OUT

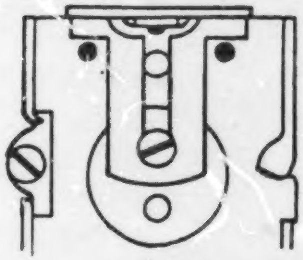
GROUNDING EQUIPMENT

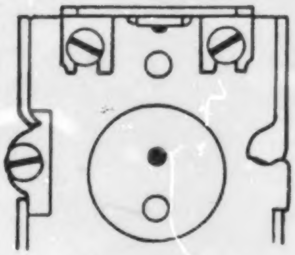

SCREW


SCREW WITH PIGTAIL


CLIP

PLASTER EARS


ONE SCREW DESIGN

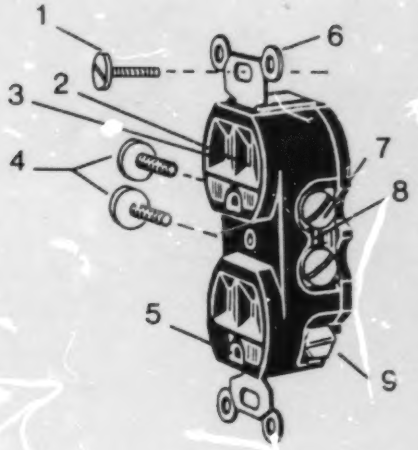

TWO SCREW DESIGN

INFORMATION SHEET 9--INSTALLATION OF RECEPTACLES AND SWITCHES

I. Receptacles

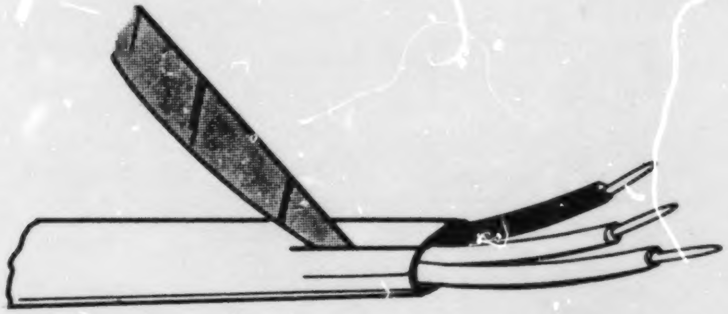
A. Parts

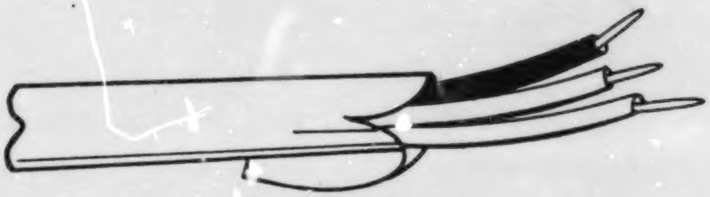
1. Mounting screws
2. Ungrounded contact slot (narrow)
3. Grounded contact slot (wide)
4. Grounded terminals (white)
5. Grounding contact slot (semi-oval)
6. Strap or yoke
7. Ungrounded terminal (copper)
8. Break-off fin
9. Grounding terminal



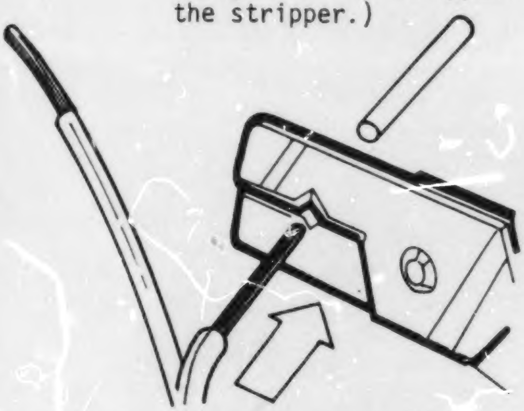
B. Receptacle installation

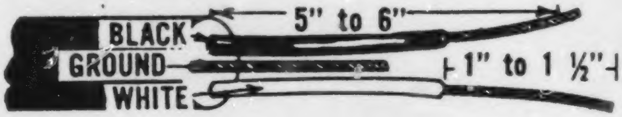
1. The electrician's helper is usually responsible for connecting the cable to the plug terminals.
2. The outside cable insulation can be removed about six inches with wire stripper or utility knife.



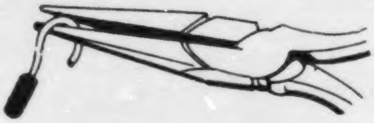


3. Strip at least 1 to 1/2 inches of insulation from the two conductors using the wire stripper. (Be sure to use the proper guage hole on the stripper.)

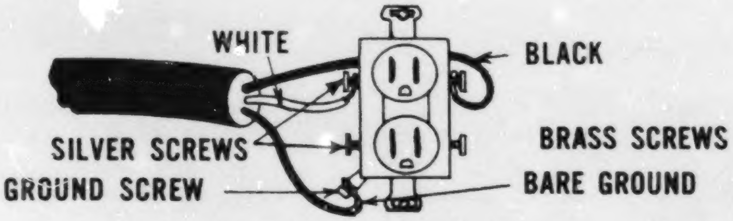



BLACK
GROUND
WHITE
5" to 6"
1" to 1 ½"

4. Make a loop on the end of each wire using the long nose pliers.

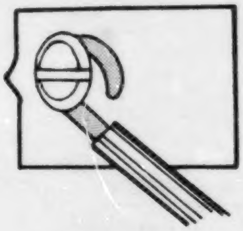


5. Using the screwdriver, attach the wire loop to the screws on the receptacle as shown.

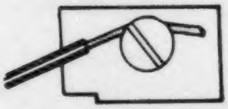

WHITE
BLACK
SILVER SCREWS
BRASS SCREWS
GROUND SCREW
BARE GROUND

(NOTE: Make sure the wire loop is on the screw in the clockwise position.)

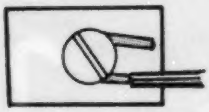
CORRECT

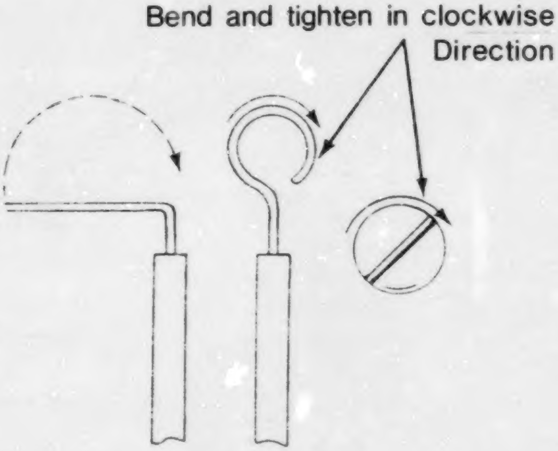


WRONG
(End not looped)



WRONG
(End too long)

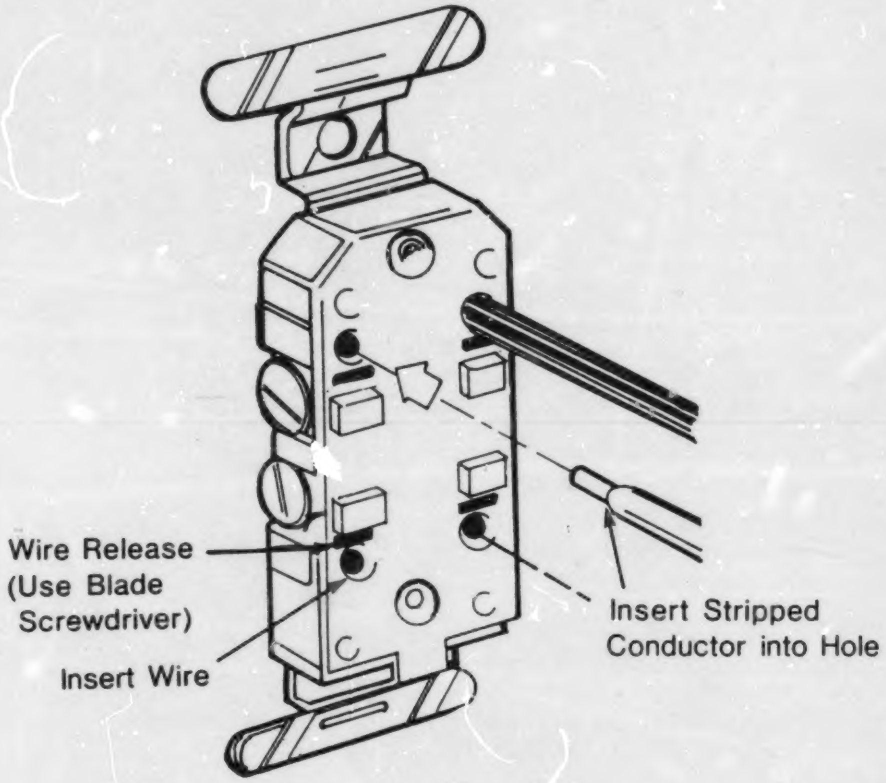


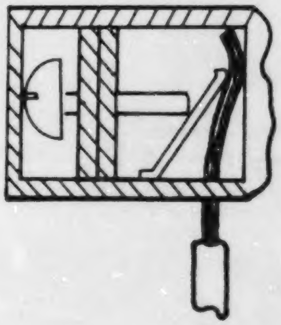

Bend and tighten in clockwise
Direction

(NOTE: Silver-colored screws on the receptacle indicate nuetral terminal, bronze-colored screws indicate the hot terminal, and green screws indicate the ground.)

6. Make sure all screws are snug, and all uninsulated wire is under the screws. Next, fasten the receptacle to the box with the mounting screws; then attach the cover. (See IS-15)

7. For the more modern receptacles that do not have terminal screws and contain back wired "quick connectors," just strip the ends of the wire about 3/4-inch and insert.

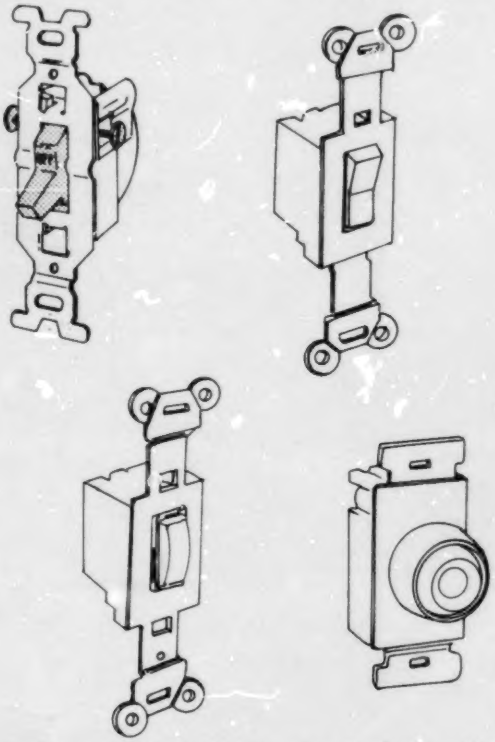

Wire Release
(Use Blade
Screwdriver)
Insert Wire
Insert Stripped
Conductor into Hole



Back-wired quick connectors. The wire is held in place by spring tension or screw tension

II. Switches--For any electrical circuit, there must be a control device. Switches are used to open and close circuits as faucets are used to control the flow of water in plumbing. Switches can be simple, complex, hand controlled, or automatically controlled. Current and voltage ratings are always listed on the switch. Pay close attention to these listings because not doing so could damage the switch or cause electrical shorts and shock.

A. Types



1. Single pole switch--most common

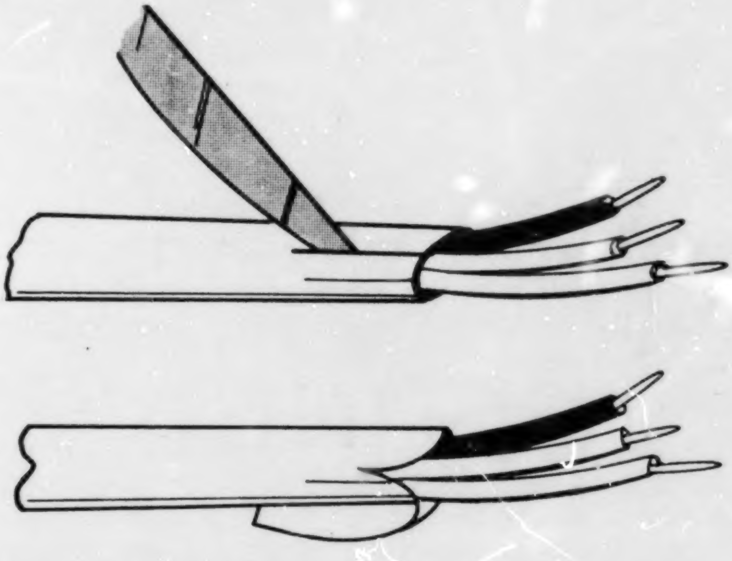
2. Three-way switch--used to control a light from two locations

3. Dimmer switch--a type of single pole switch used to control the amount of voltage going to fixture

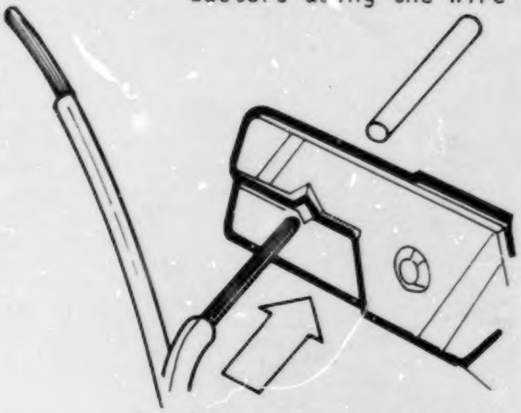
4. Push-button switch--identical to the single pole switch except it has a push-button instead of a lever

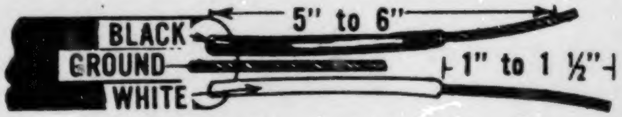
B. Switch installation--single pole

1. The outside cable insulation can be removed about six inches with wire stripper or utility knife.

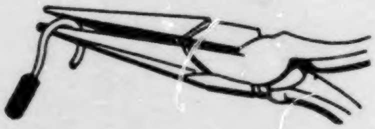


2. Strip at least 1 to 1 1/2 inches of insulation from the two conductors using the wire stripper.

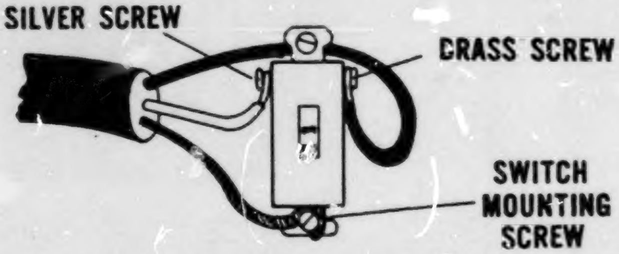



BLACK
GROUND
WHITE
5" to 6"
1" to 1 ½"

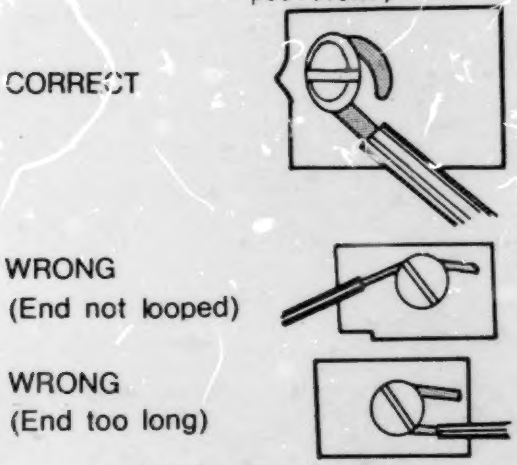
3. Make a loop on the end of each wire using the long nosed pliers.

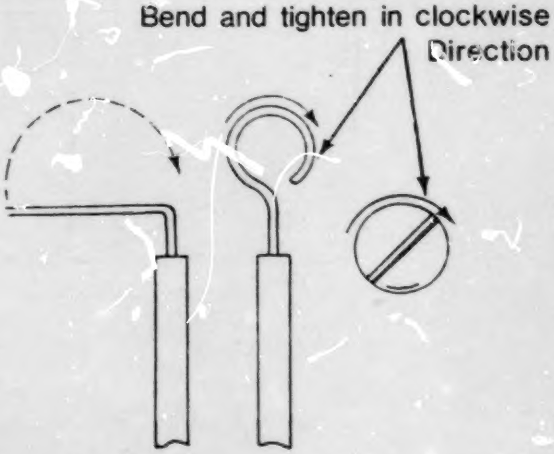


4. Using the screwdriver, attach the wire loops to the screws on the switch as shown.


SILVER SCREW
BRASS SCREW
SWITCH MOUNTING SCREW

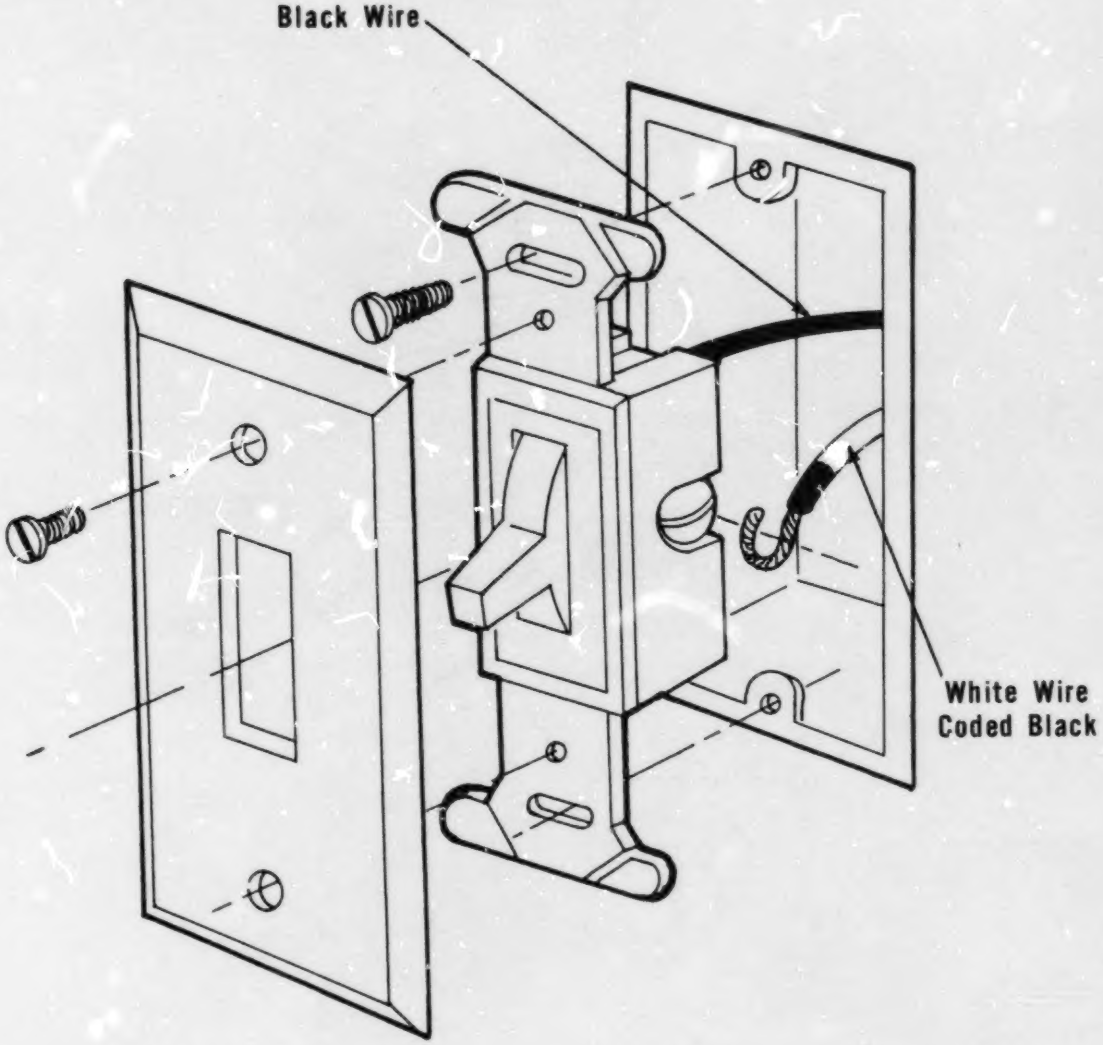
(NOTE: Make sure the wire loop is on the screw in the clockwise position.)


CORRECT
WRONG
(End not looped)
WRONG
(End too long)

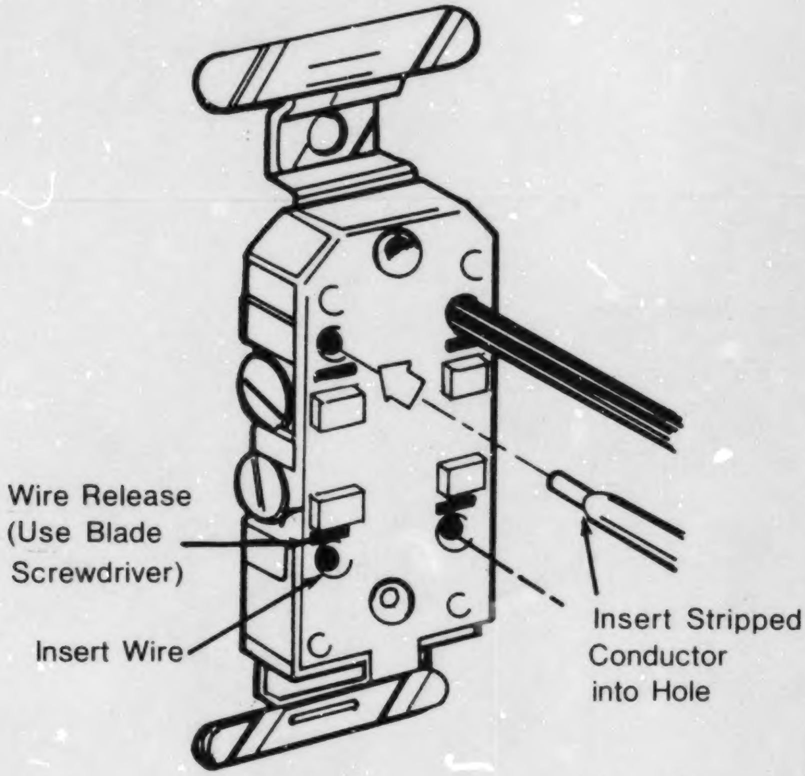

Bend and tighten in clockwise Direction

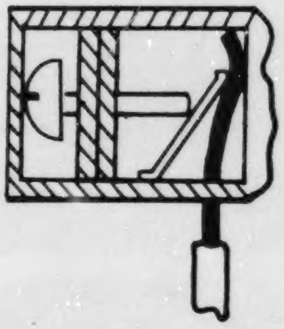
(NOTE: Silver-colored screws on the switch indicate neutral terminal. Bronze-colored screws indicate the hot terminal. Green-colored screws indicate ground.)

5. After making sure all screws are snug and all uninsulated wire is under the screws, fasten the switch to the box with the mounting screws; then attach the cover.


Black Wire
White Wire
Coded Black

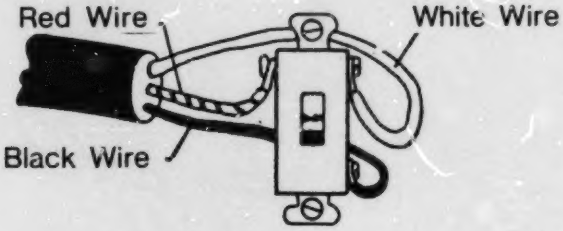
6. For the more modern switches that do not have terminal screws and contain back-wired "quick connectors," just simply strip the ends of the wire about 3/4-inch and insert.


Wire Release
(Use Blade
Screwdriver)
Insert Wire
Insert Stripped
Conductor
into Hole

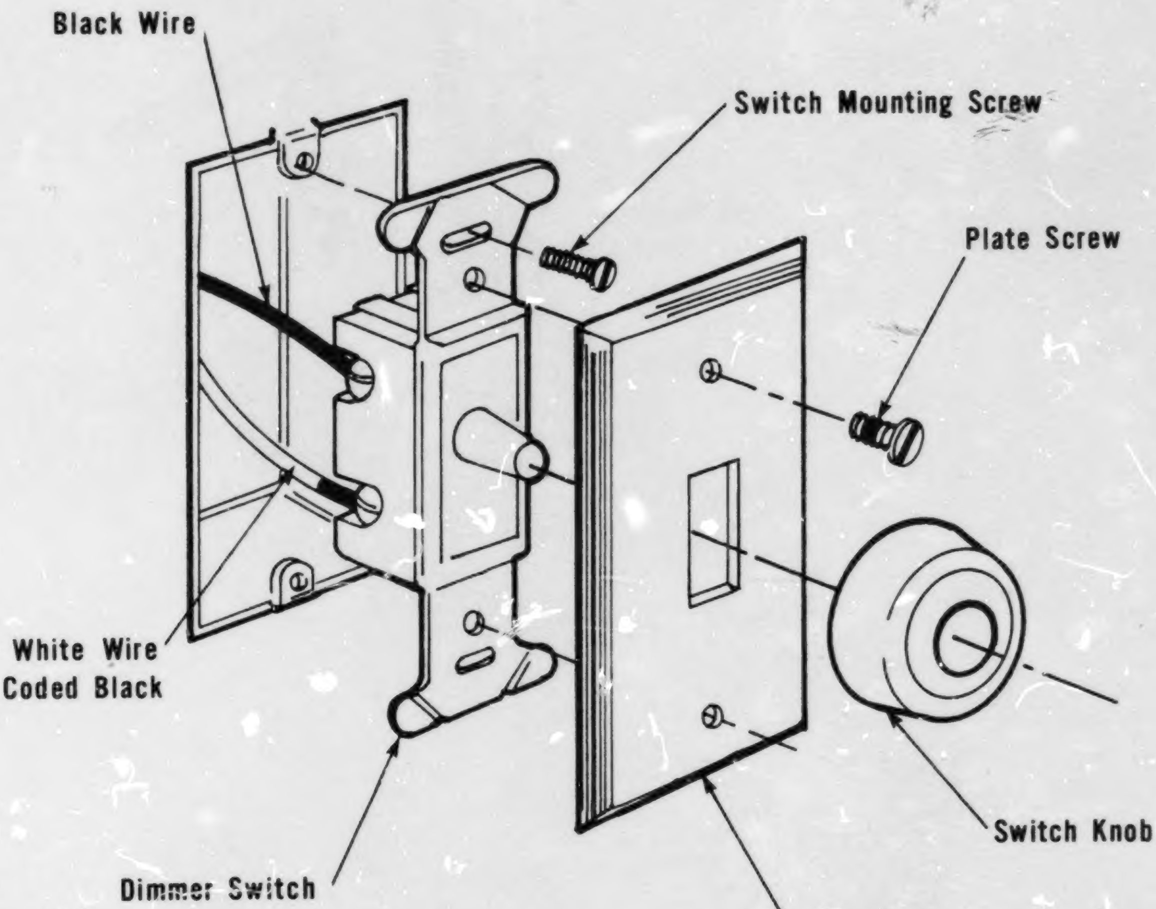


Back-wired "quick connectors. The wire is held in place by spring tension or screw tension

C. Switch installation (three way)--Follow the same steps as single pole but wire as shown.

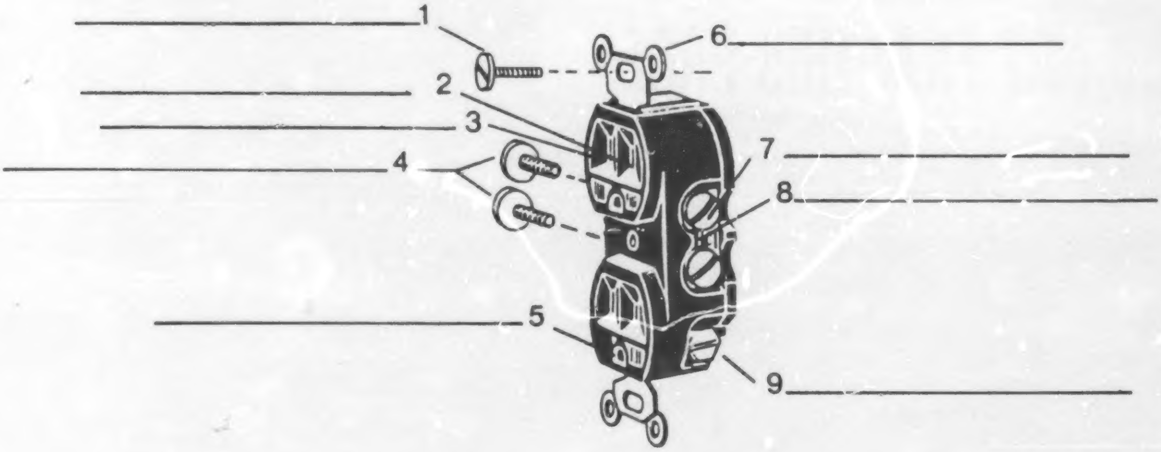

Red Wire
White Wire
Black Wire

D. Switch installation (dimmer)-- Follow the same steps as single pole


Black Wire
Switch Mounting Screw
Plate Screw
White Wire Coded Black
Switch Knob
Dimmer Switch
Original Cover Plate

ASSIGNMENT SHEET 15--INSTALLATION OF RECEPTACLES AND SWITCHES

A. Label the parts of the receptacle.



B. List the five major steps in receptacle installation.

1.

2.

3.

4.

5.

C. What do silver-colored screws, bronze-colored screws, and green-colored screws on the receptacles and switches represent?

1. silver-colored--

2. bronze-colored--

3. green-colored--

D. List the four types of switches.

1.

2.

3.

4.

E. List the five major steps in switch installation.

1.

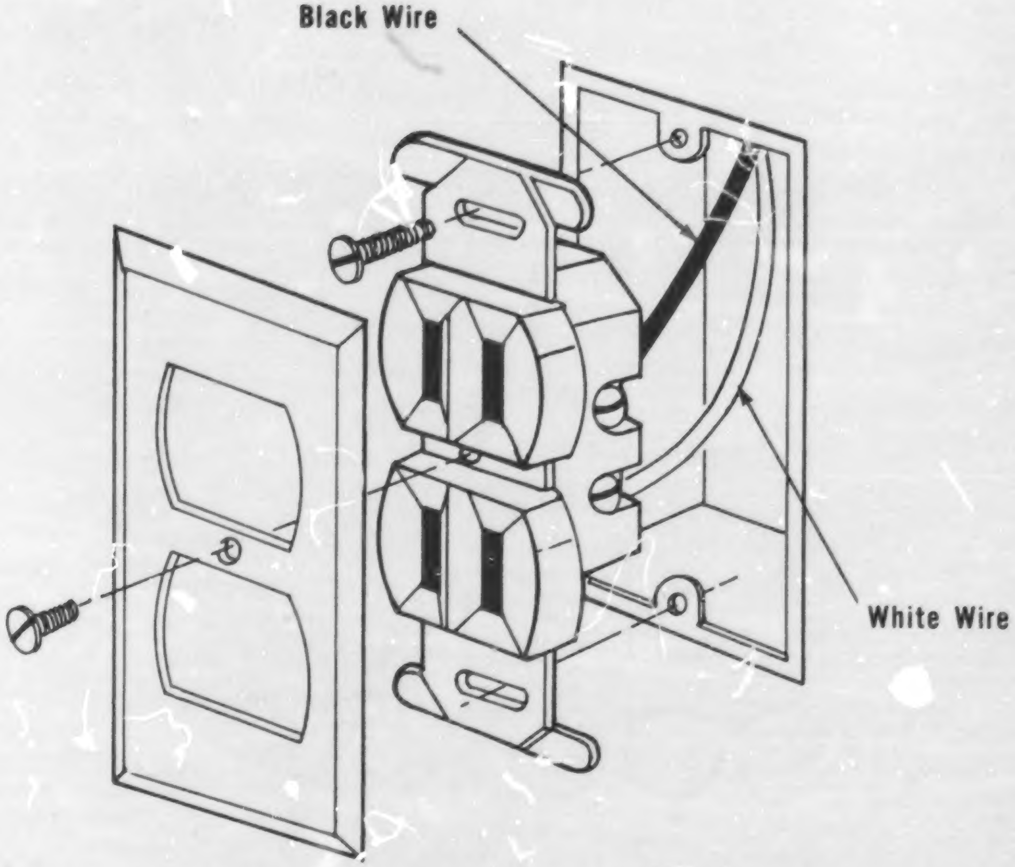
2.

3.

4.

5

COMPLEX RECEPTACLE


Black Wire
White Wire

INFORMATION SHEET 10--ELECTRICAL FIXTURES

I. Types of Fixtures

  A. Fluorescent

  B. Chandeliers--multiple sockets

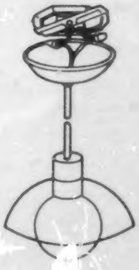
  C. Recessed

  D. Ceiling fixtures--pipe-supported (some with threaded ears and some without)

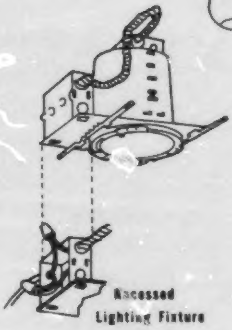
  E. Outdoor light fixture

Flourescent Light Fixture

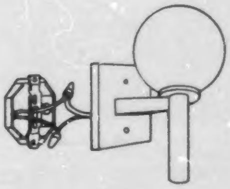
Chandeliers



Ceiling Fixture



Recessed Lighting Fixture



Outdoor Light Fixture

II. Parts of Fluorescent Lamp Fixture

  A. Fixture

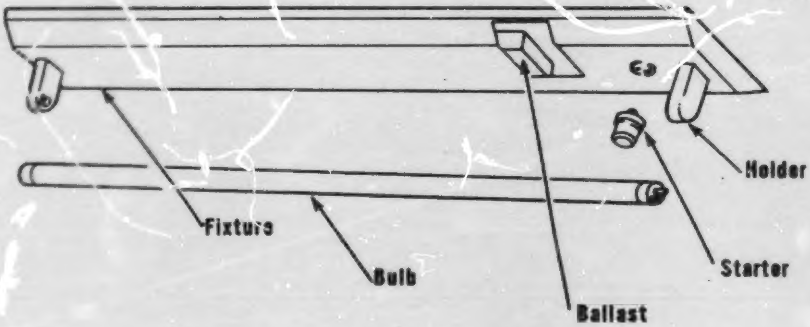
  B. Bulb

  C. Ballast

  D. Starter

  E. Holder

  F. Socket



III. Parts of a Multiple Socket, Pipe-Supported Light Fixture

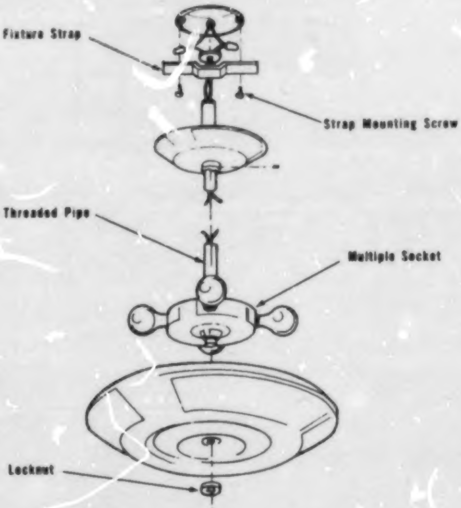
A. Fixture strap

B. Threaded pipe

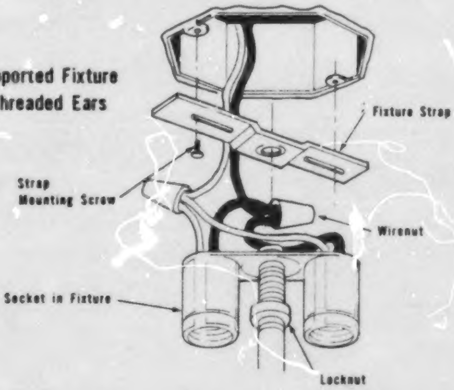
C. Locknut

D. Multiple socket

E. Strap mounting screws

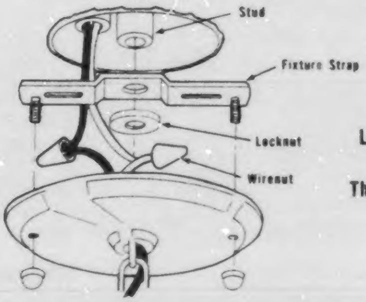

Fixture Strap
Strap Mounting Screw
Threaded Pipe
Multiple Socket
Locknut

IV. Parts of a Pipe-Supported Fixture with Threaded Ears


Pipe-Supported Fixture With Threaded Ears

Fixture Strap
Strap Mounting Screw
Wirenut
Socket in Fixture
Locknut

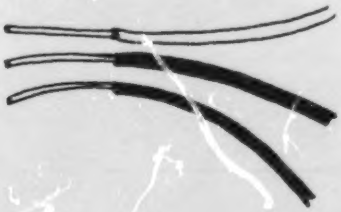
V. Parts of a Lamp Fixture without Threaded Ears


Lamp Fixture With no Threaded Ears

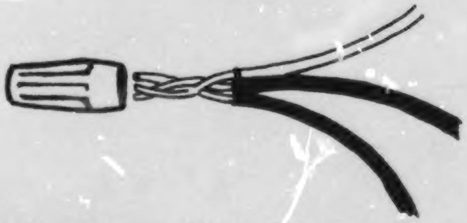
Stud
Fixture Strap
Locknut
Wirenut

VI. General Installation Techniques

A. Make sure you have about 1 inch to 1 1/2 inch of bare copper (cable) conductor on the end of each line before you start connection.



B. Use wirenuts to splice wires together.



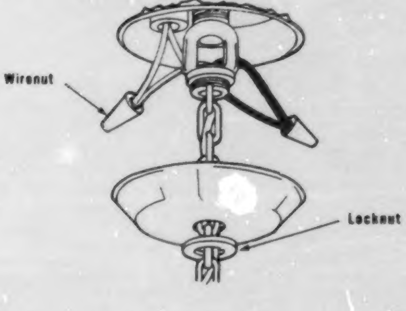
C. Hold the fixture to support its weight until you attach mounting screws.

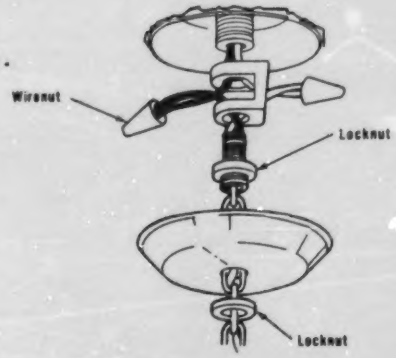
(NOTE: The fixture should not be allowed to swing freely on just the wirenut connection because the fixture's weight could cause it to pull loose and fall.)

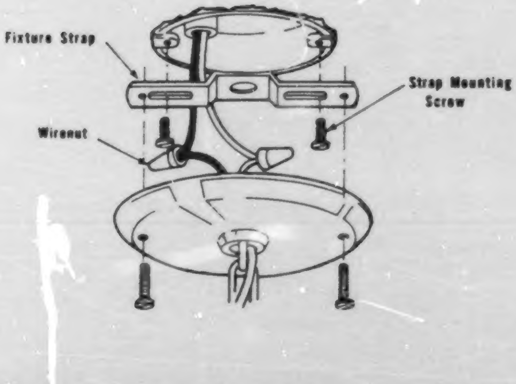
D. Attach mounting screws.

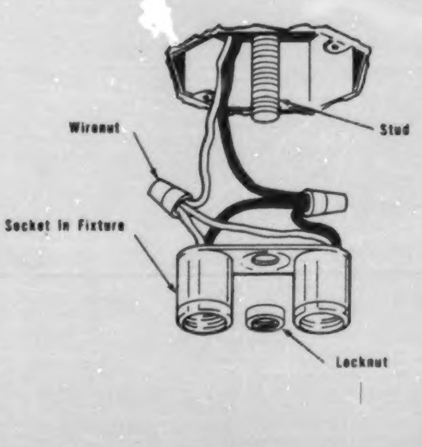
(NOTE: Don't overtighten as this may cause the fixture not to hang straight.)

E. Attach the globes and other decorations.


Wirenut
Locknut


Wirenut
Locknut
Locknut

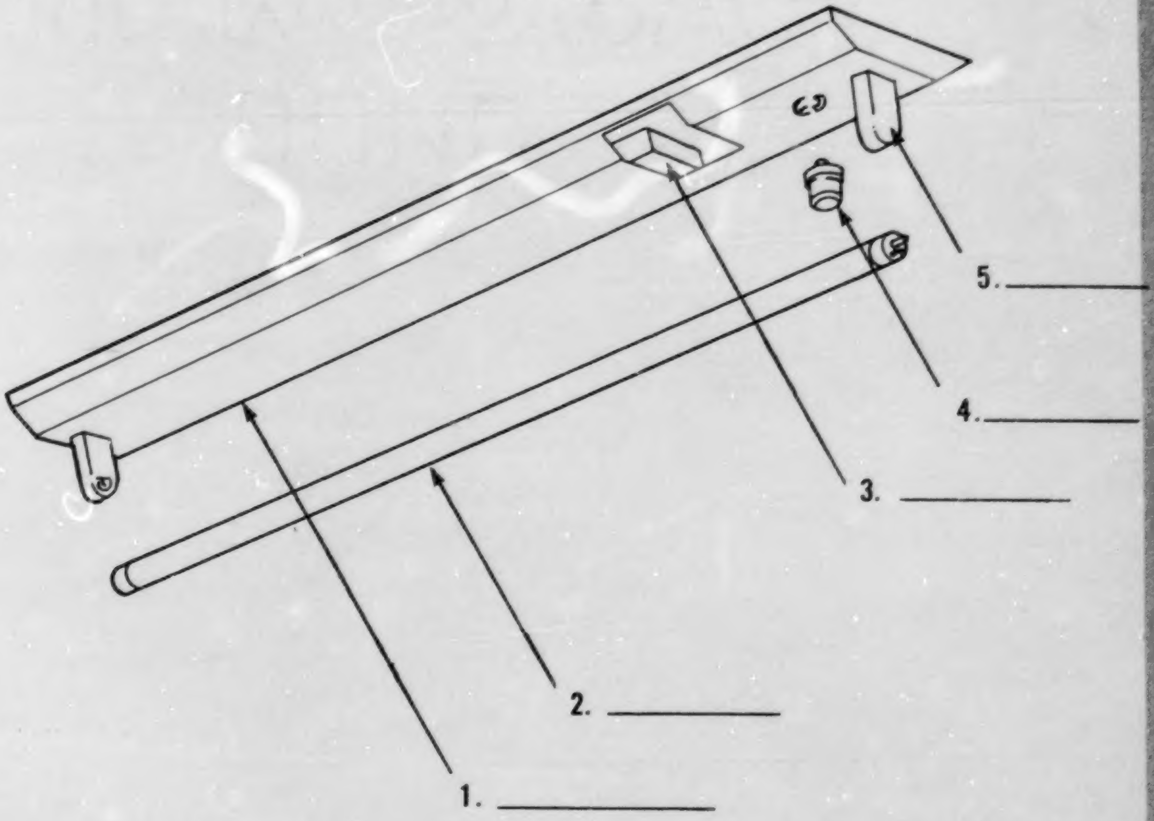

Fixture Strap
Strap Mounting Screw
Wirenut


Stud
Wirenut
Socket In Fixture
Locknut

ASSIGNMENT SHEET 16--IDENTIFY PARTS OF A FLUORESCENT LAMP FIXTURE

Using the list of terms, select the correct name of each part of a fluorescent lamp fixture and write it in the correct blank.

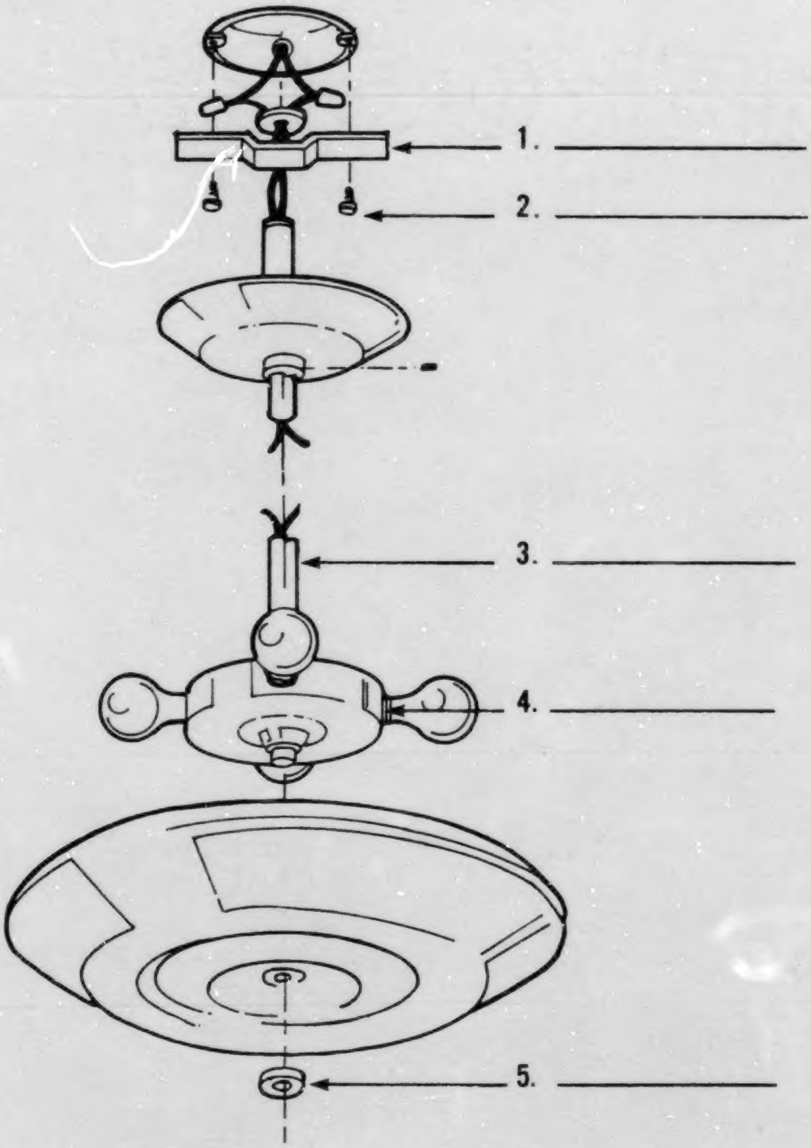
Starter	Fixture	Ballast
Holder	Bulb	



ASSIGNMENT SHEET 17--IDENTIFY PARTS OF A PIPE-SUPPORTED LAMP FIXTURE

Using the list of parts given, select the correct name of each part of a pipe-supported lamp fixture and write it in the correct blank.

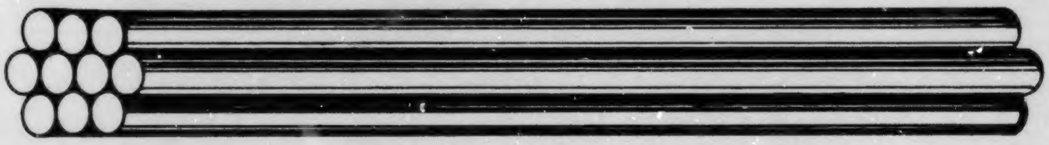
Multiple Socket
Fixture Strap
Strap Mounting Screw
Threaded Pipe
Locknut



INFORMATION SHEET 11--BENDING ELECTRICAL METALLIC TUBING (EMT-CONDUIT)

I. EMT General Information

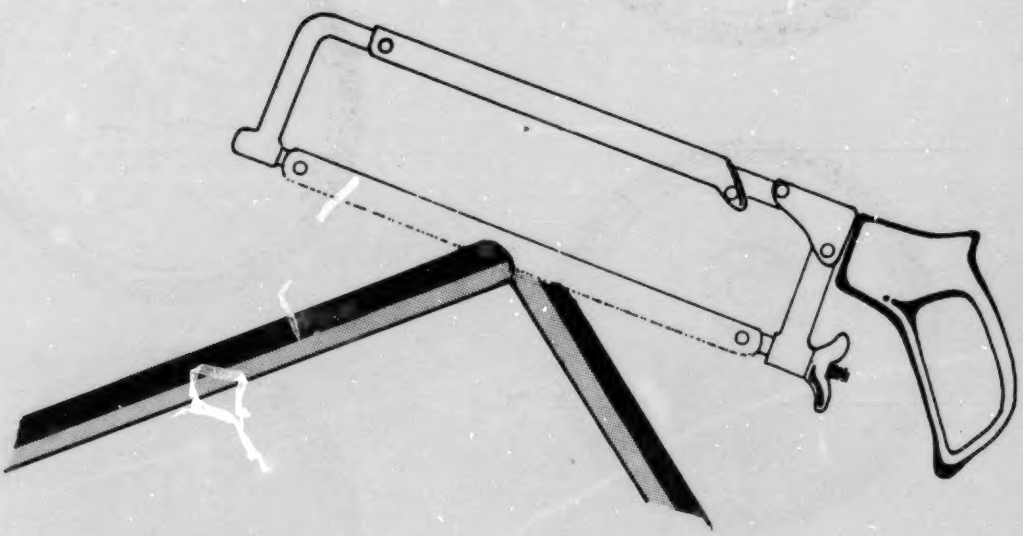
A. EMT is usually purchased in bundles of 100 feet.



B. Trades sizes range from 1/2 inch to four inches.

Thin Wall			Trade Size Inches
Diameter Inches			
Inside Nearest 1/16"	Inside	Outside	
5/8	0.622	0.706	1/2
13/16	0.824	0.922	3/4
1-1/16	1.049	1.163	1
1-3/8	1.380	1.508	1-1/4
1-5/8	1.610	1.738	1-1/2
2-1/16	2.067	2.195	2
2-3/4	2.731	2.875	2-1/2
3-3/8	3.356	3.500	3
——	——	——	3-1/2
4-5/16	4.334	4.500	4

C. Conduit is usually cut with a hacksaw.



D. Once conduit has been cut, it must be deburred with a file or a special deburring tool called a reamer.

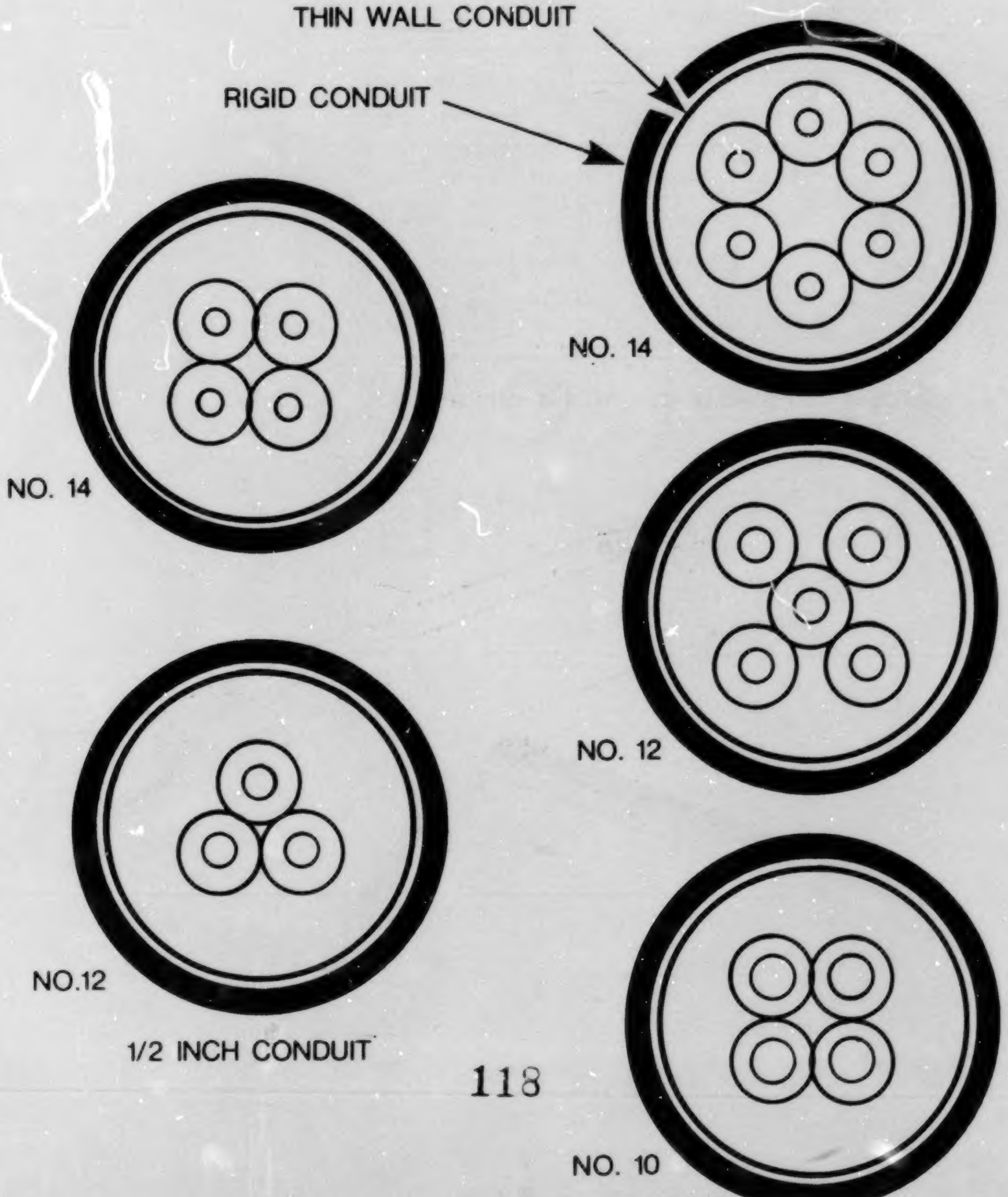
REMEMBER: Cut metal is very sharp. Be careful so as to avoid cuts and bruises.

E. Two major textures

1. Thin wall

2. Thick wall (rigid)

(NOTE: The following shows the size of each and the number of common size wires or conductors which are allowed for each size.)

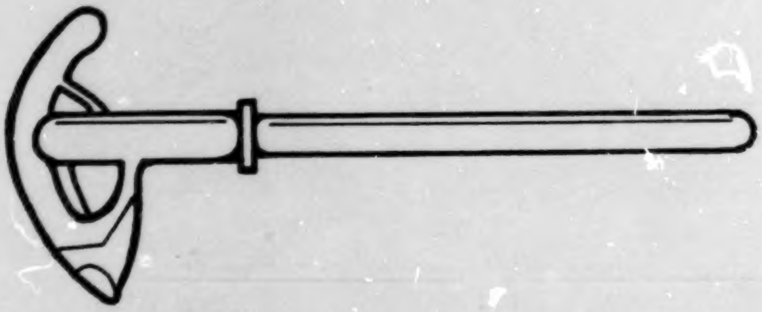

THIN WALL CONDUIT
RIGID CONDUIT
NO. 14
NO. 14
NO. 12
NO.12
NO. 10

1/2 INCH CONDUIT

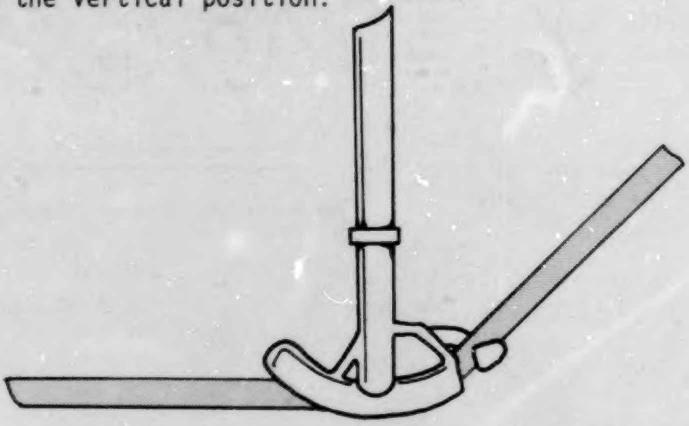
3/4 INCH CONDUIT

II. Bending EMT

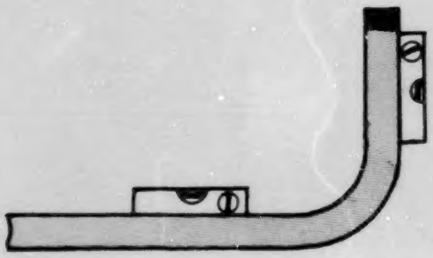
A. The conduit hickey is a tool specifically designed to bend metal pipe. It has high supporting sidewalls to prevent flattening or kinking of the tube during the process. It also has a long arc that permits the making of 90 degree bends in a single sweep without moving the bender to a new position along the tubing.



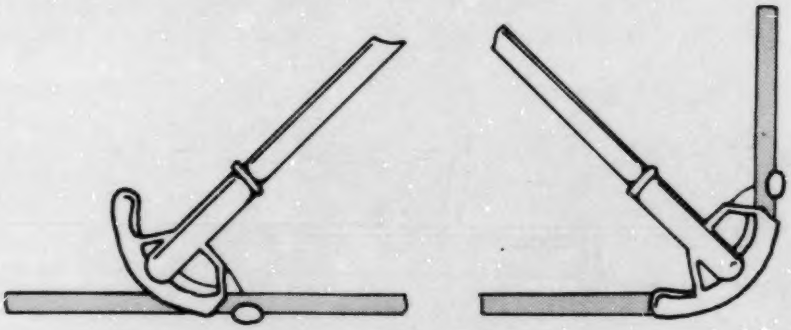
B. For a 45 degree bend, the bender is placed on the conduit and the handle is in the vertical position.



C. 90 degree bends are easily checked by using a level.

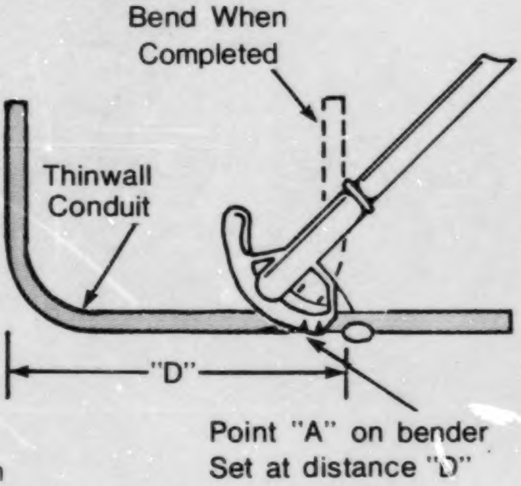


D. 90 degree bends may be used to turn corners.



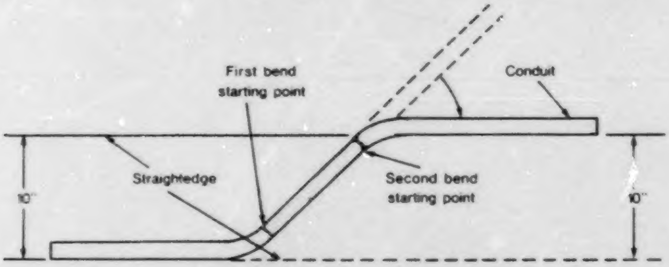
E. Back-to-back bends are simply two 90 degree bends.

1. Make a 90 degree bend.
2. Mark the distance or length on the tubing as D.
3. Reverse the direction of the bender and point A of the bender is placed at point D.
4. Raise the bender to form the second 90 degree angle.

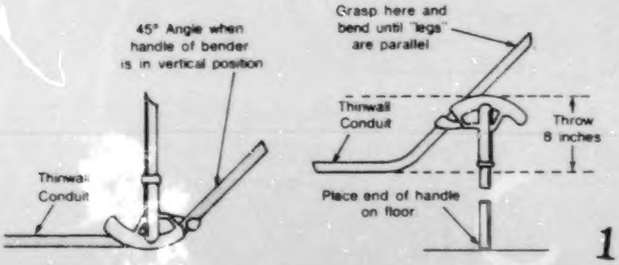

Bend When Completed
Thinwall Conduit
"D"
Point "A" on bender Set at distance "D"

F. Offsets

1. Used to go around obstruction
2. Easily checked with a level


First bend starting point
Conduit
Straightedge
Second bend starting point
10"
10"

The second bend on an offset can be more readily determined if parallel lines are drawn on the floor using a straightedge.

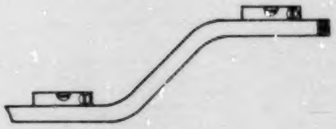

45° Angle when handle of bender is in vertical position
Thinwall Conduit
Grasp here and bend until "legs" are parallel
Thinwall Conduit
Throw 8 inches
Place end of handle on floor

Repositioning the conduit is required to effectively make the second bend on an offset.

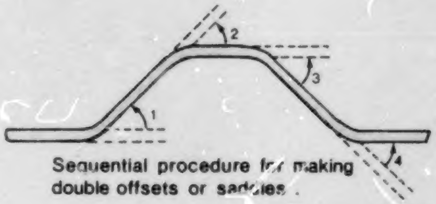
G. Saddles or double offsets

1. Used to go around obstructions

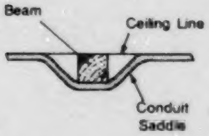
2. The illustration shows the methods of construction



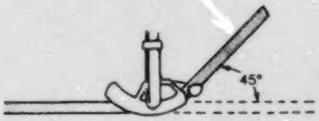
A pocket level may be used to check the accuracy of an offset.

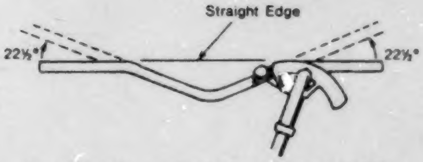


Sequential procedure for making double offsets or saddles.



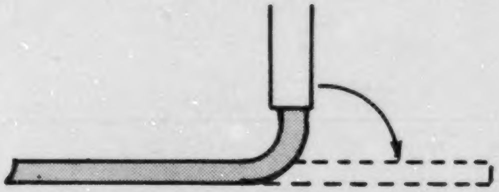
Double offsets or saddles are used to clear obstructions.





An alternate method of making a saddle.

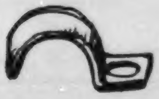
H. Straightening conduit--when learning to bend conduit, it is possible you will make bends off their mark. Find a piece of conduit or pipe slightly larger than the EMT you are using and straighten as shown below.



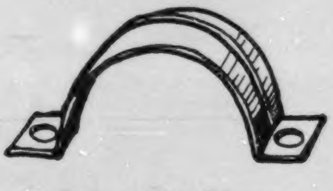
III. Rules Concerning Bends and EMT

A. The National Electrician's Code (NEC) states that bends in tubing will be made so that the tubing will not beinjured and that the internal size of the tubing will not be reduced.

B. EMT will also be firmly fastened every 10 feet and within three feet of each outlet box with proper connectors as shown below.



One Hole Strap



Two Hole Strap

ASSIGNMENT SHEET 18--BENDING ELECTRICAL METALLIC TUBING

A. List five general facts concerning EMT.

1.

2.

3.

4.

5.

B. What is the conduit hickey used for?

C. List five major bends made with the conduit hickey.

1.

2.

3.

4.

5.

D. What is one way to straighten conduit?

ELECTRICIAN'S HELPER

UNIT TEST--PART 1

A. Match the terms to their correct definitions by placing the correct letter in the blank at the left.

_____ 1. Kilowatt

_____ 2. Switch

_____ 3. Kilowatt hour

_____ 4. Horsepower

_____ 5. Electricity

_____ 6. Watt

_____ 7. Conductors

_____ 8. Volt

_____ 9. Hot wire

_____ 10. Ground

_____ 11. Circuit

_____ 12. Neutral wire

a. a kind of energy or power which can be changed into useful form

b. a unit for measuring electrical power

c. 1,000 watts

d. a unit for measuring the force of an electric current

e. a device used to open or close a circuit

f. the complete path of an electrical current

g. 1,000 watts used for one hour

h. a unit of mechanical power which is the same as 746 watts of electrical power

i. materials through which electrical current flows

j. the wire that carries the electric current

k. a wire that does not carry electrical current

l. a connection to the earth which serves as a return circuit

B. List four uses of electricity.

1.

2.

3.

4.

C. Place an "X" in the blank beside the terms below which identify a type of electrical power plant.

_____ 1. Hydro-electric

_____ 2. Gas-fired

_____ 3. Wood-fired

_____ 4. Atomic

D. Place an "X" in the blank beside the terms below which identify a type of individually owned electrical generator.

_____ 1. Wind powered

_____ 2. Horse-powered

_____ 3. Gasoline-powered

_____ 4. Solar-powered

E. Place an "X" in the blank beside the terms below which identify a type of power company.

_____ 1. Public

_____ 2. Combined

_____ 3. Cooperative

_____ 4. Private

F. Arrange the types of power lines listed below in the proper order from power plant to user by placing the number 1, 2, or 3 in the blank beside the term.

_____ 1. Distribution line

_____ 2. Transmission line

_____ 3. Service line

G. Identify voltage sizes of power sources by filling in the following blanks with either 110 or 220.

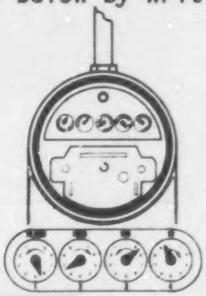
A house with three electric lines leading to it has (1) __________-volt service, and if there are only two lines leading to it, it has a (2) ________-volt service.

H. List two types of electrical rates.

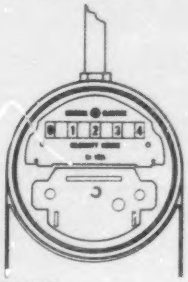
1.

2.

I. Identify the two meters below by writing the name of each in the blank below.



1. ________________________



2. ________________________

J. List ten job duties of an electrician's helper.

1.

2.

3.

4.

5.

6.

7.

8.

9.

10.

K. List three dangers of the job of an electrician's helper.

1.

2.

3.

L. List five special qualities needed by an electrician's helper.

1.

2.

3.

4.

5.

ELECTRICIAN'S HELPER

UNIT TEST--PART 2

A. Match the electrical safety terms listed to their definitions by placing the correct letter in the blanks at the left.

_____ 1. Accident

_____ 2. Safety

_____ 3. Electrical shock

_____ 4. Defective

_____ 5. Approved

_____ 6. Ground

_____ 7. Short circuit

_____ 8. Overload

_____ 9. Live wire

_____ 10. Dead circuit

_____ 11. Modification

_____ 12. Qualified person

a. electrical current passing through a person's body

b. any unplanned event which causes injury or damage

c. state of being free from danger, risk or injury

d. a connection to the earth which serves as a return circuit and reduces danger

e. not working correctly; faulty

f. current-carrying wire

g. a disconnected circuit

h. a side current caused by faulty wiring

i. said to meet the least possible rules

j. a circuit forced to carry more electric current than it is made to carry

k. a slight change in form or use

l. a person who knows the work area involved

B. Place an "X" beside the words below that can be the result of an electrical accident.

_____ 1. Death

_____ 2. Crippling

_____ 3. Loss of time

_____ 4. Loss of material

_____ 5. Loss of job

C. Place an "X" in the blank beside the correct things to do to help an electrical shock victim.

_____ 1. Turn off electricity causing shock.

_____ 2. Remove hot wire from victim, using a metal rod.

_____ 3. Give mouth-to-mouth resuscitation after removing the source of electricity.

_____ 4. Call an ambulance or doctor.

_____ 5. Notify the gas company.

_____ 6. Watch for possible electrical fire.

D. List the three classes of fires.

1.

2.

3.

E. On what class or classes of fire may each of the following types of extinguishers be used?

Class

1. Soda-acid _____

2. Pressurized water _____

3. Foam _____

4. Carbon dioxide _____

5. Dry chemical _____

F. Place an "X" beside the correct electrical installation safety factors.

_____ 1. Check circuit with test light before starting work.

_____ 2. Keep equipment and tools dry.

_____ 3. Work on either side of the circuit.

_____ 4. Wear approved hard hat.

_____ 5. Use painted metal ladder.

_____ 6. Cut away from your body when stripping wire.

ELECTRICIAN'S HELPER

UNIT TEST--PART 3

A. Match the terms to their definitions by placing the correct letter in the blanks at the left.

_____ 1. Outlet

_____ 2. Conduit

_____ 3. Receptacle

_____ 4. Duplex

a. place in wiring where appliances may be attached to the receptacle

b. metal or plastic pipe used to protect electric wires

c. device installed at outlet to connect the appliances with electricity

d. double receptacle

B. Place an "X" in the blank beside the types of wire conductors.

_____ 1. Metallic armored cable (BX)

_____ 2. Thermal wire cable (TW)

_____ 3. Non-metallic cable (NM)

_____ 4. Power service cord (SJ)

_____ 5. Lamp cord (rubber or braided insulation)

C. Select the correct types of electrical boxes by placing an "X" in the blank beside the proper terms only.

_____ 1. Rectangular switch or outlet

_____ 2. Octagonal ceiling or junction

_____ 3. Sub mounted

_____ 4. Shallow

_____ 5. Waterproof

D. Place an "X" beside the types of electrical connectors.

_____ 1. Coupler

_____ 2. Indentor type

_____ 3. Wire nuts

_____ 4. Soldered and taped

_____ 5. Common type

E. List three types of switches.

1.

2.

3.

F. Select the correct types of electrical outlets and receptacles by placing an "X" in the blank beside the correct term only.

_____ 1. 208-240V

_____ 2. Duplex with ground

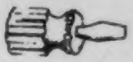
_____ 3. Weatherproof

_____ 4. Shockproof

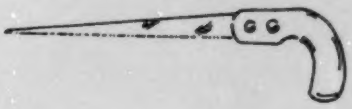
_____ 5. Duplex without ground

G. Match the electrical tools with the names by placing the correct letter in the blanks at the left.

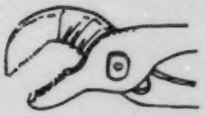
_____ 1.



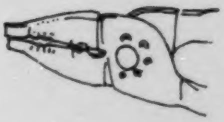
_____ 2.



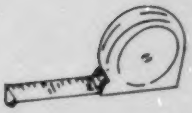
_____ 3.



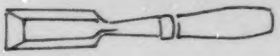
_____ 4.



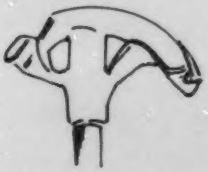
_____ 5.



_____ 6.



_____ 7.



a. Lineman plier

b. Slip-joint plier

c. End cutters

d. Conduit bender

e. Channel lock pliers

f. Keyhole saw

g. Hack saw

h. Stubby screwdriver

i. Cold chisel

j. Steel tape

k. Wood chisel

l. Wire stripper

m. Phillips screwdriver

n. Folding rule

o. Fish tape

H. Place an "X" beside those things found in an electrical service entrance.

_____ 1. Neutral bar

_____ 2. Main breaker

_____ 3. Three-way switch

_____ 4. Duplex outlet

_____ 5. Meter box

_____ 6. Entrance ell

I. Match the terms on the left to their correct definitions by placing the correct letter in the blanks at the left.

_____ 1. Continuity tester

_____ 2. ∞

_____ 3. Volt-ohm meter

_____ 4. Ohm

_____ 5. VAC

a. a unit for measuring electrical resistance

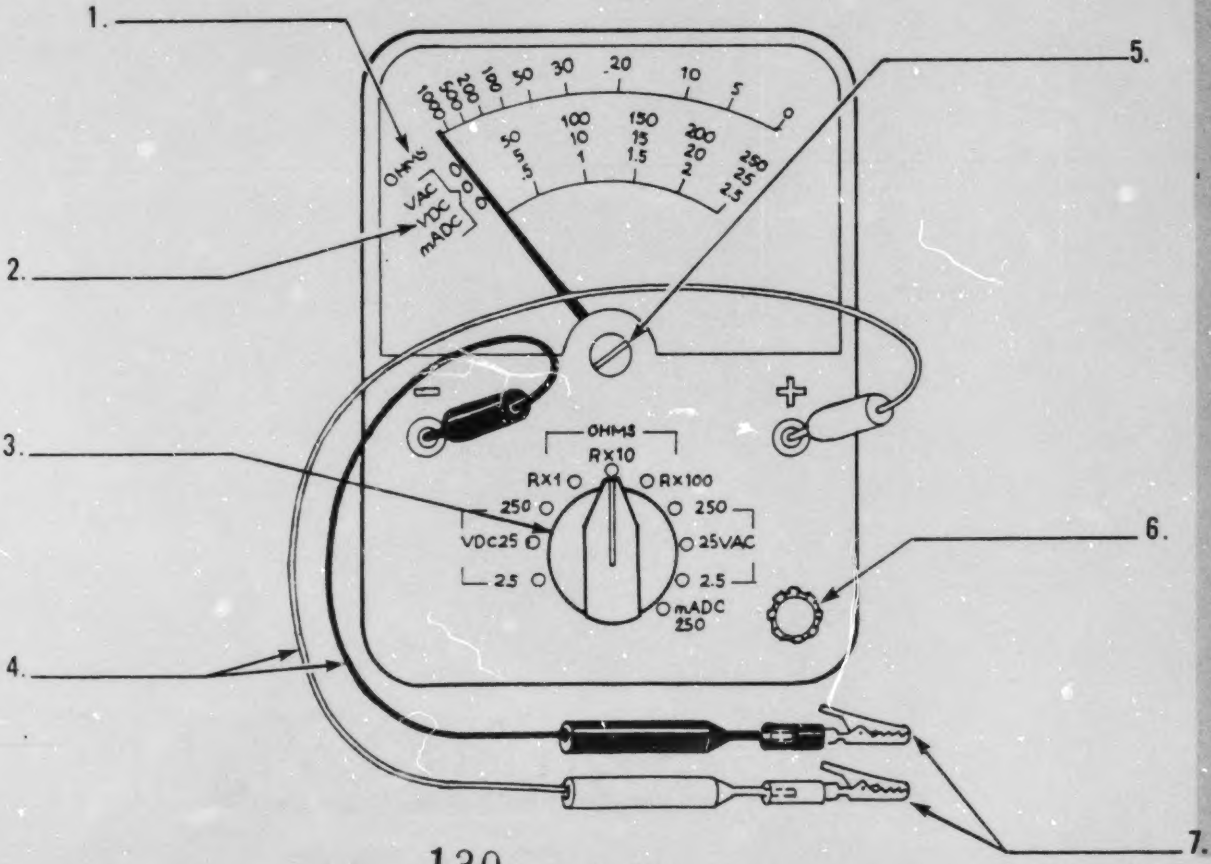
b. volts alternating current

c. a simple electrical measuring instrument used to troubleshoot problems

d. symbol meaning infinity

e. has a battery inside to test if circuit is broken

M. Identify the parts of a volt-ohm meter.


1.
2.
3.
4.
5.
6.
7.
1000
500
200
100
50
30
20
10
5
0
50
5
.5
100
10
1
150
15
1.5
200
20
2
250
25
2.5
OHMS
VAC
VDC
mADC
−
+
OHMS
RX10
RX1
RX100
250
VDC25
2.5
250
25VAC
2.5
mADC
250

ELECTRICIAN'S HELPER

UNIT TEST--PART 4

A. Match the terms to their correct definitions by placing the correct letter in the blanks at the left.

_____ 1. Honing

_____ 2. Drilling

_____ 3. Straightedge

_____ 4. Bevel

_____ 5. Set

_____ 6. Perpendicular

_____ 7. Boring

_____ 8. Planing

_____ 9. Kerf

_____ 10. Plumb

_____ 11. Convex

_____ 12. Wedges

a. a straight strip of wood or metal used with a level or for making straight lines

b. at a 90° angle to a surface

c. trimming and fitting wood with a sharp-edged tool

d. making a hole with a drill

e. making a hole larger than 1/4 inch with an expansion bit

f. removing the wire edge from sharpened blades with an oilstone

g. the ground or angled surface on a chisel or plane iron

h. the staggering of teeth on a saw so that the body of the saw does not bind

i. the width of the slot the saw leaves in the wood

j. an outward rounded or bell-faced surface

k. small pieces of metal driven into the head of a hammer to keep it in place

l. a straight up and down or vertical position

B. Answer the following statements True or False by placing a T for True or an F for False in the space at the left.

_____ 1. Use tools correctly.

_____ 2. Keep tools working properly.

_____ 3. Hammer heads cannot come off wooden handles so they do not need to be checked.

_____ 4. When going to a job, stuff your pockets with tools so you will only have to make one trip.

_____ 5. Tools should not be dropped.

_____ 6. Slightly dull tools are safer than sharp ones.

_____ 7. Tools should remain dirty and unoiled.

_____ 8. Return tools to the storage area after use.

ELECTRICIAN'S HELPER

UNIT TEST--PART 5

A. Match the terms to their definitions by placing the correct letter in the blanks at the left.

_____ 1. RPM

_____ 2. Margin of safety

_____ 3. Maintenance

_____ 4. Feed

_____ 5. Portable

_____ 6. Receptacle

a. the care and upkeep of equipment

b. the speed at which the blade, bit, or cutter of a power tool is moved into the material

c. light and easily movable tools that are usually hand-held while being used

d. the power source for a power tool

e. the number of turns in a minute of a blade, bit, or cutter in a power tool

f. Keeping hands a certain distance away from the blade, bit, or cutter at all times

B. Place an "X" beside the correct safety rules below.

_____ 1. Become familiar with how to use each machine before using it.

_____ 2. Be alert when operating power tools.

_____ 3. Make adjustments with power tools turned off.

_____ 4. Do not allow others to distract you.

_____ 5. Remove any safety guards that are in your way.

_____ 6. Wear safety glasses when using or around power tools.

_____ 7. Be sure machines, receptacles, and plugs are properly grounded.

_____ 8.. Develop a good safety attitude.

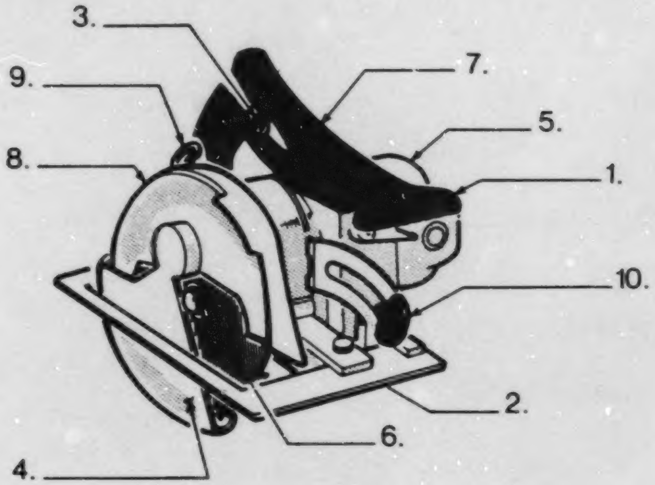
_____ 9. Colored stripes around machines are for decoration.

_____ 10. Have permission from your employer or instructor before using power tools.

_____ 11. Leave maintenance up to your instructor.

C. Label each of the parts of the circular saw.

Handle
Switch
Motor
Upper guard
Telescoping guard
Hand knob
Tilt adjustment
Base
Depth adjustment
Blade



D. Select the correct safety rules for the portable circular saw by writing either safe or unsafe in each of the blanks below.

_____ 1. Select the right blade and be sure it is sharp.

_____ 2. Use the same blade for all jobs.

_____ 3. Support your work correctly.

_____ 4. Force the saw into the work.

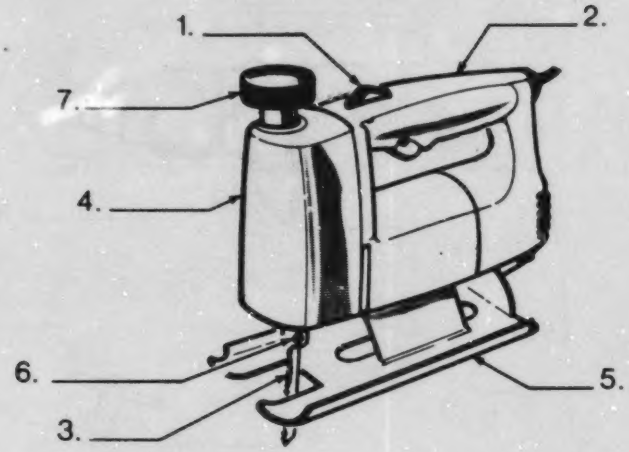
_____ 5. The blade should clear the work two inches.

_____ 6. Use both hands when sawing.

_____ 7. Use the sawhorse for practice by cutting into it.

E. Label the parts of a saber saw.

Switch
Guide knob
Housing
Blade screw
Blade
Base
Handle



F. Select the correct safety rules for the saber saw by writing either safe or unsafe in each of the blanks below.

_____ 1. Use any blade on the saw.

_____ 2. Cut curves sharply.

_____ 3. Do not support the end being cut off.

_____ 4. Do not saw into the sawhorse.

_____ 5. Hold the blade against the work before turning it on.

_____ 6. Leave the saw plugged in to make adjustments.

_____ 7. Only one tooth of the blade should touch thin material.

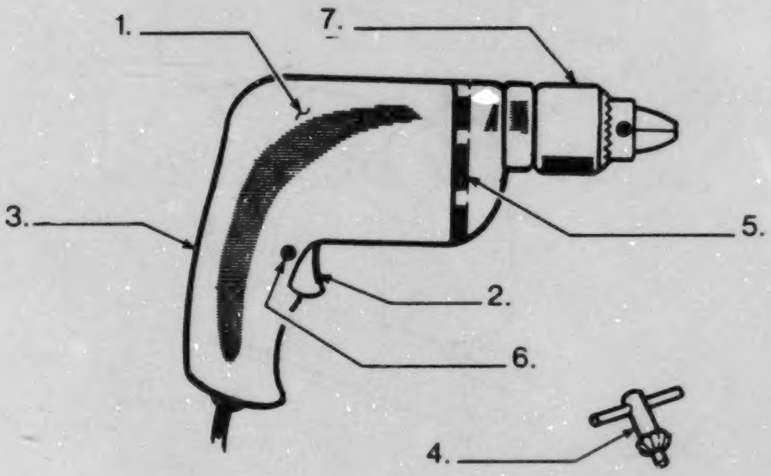
_____ 8. Make sure the blade will cut completely through the material.

_____ 9. Pull up lightly on the saw.

_____ 10. Remove the saw from the cut with the blade moving.

G. Label the parts of a portable drill.

Housing	Switch lock	Cooling vents
Geared key chuck	Chuck wrench	Handle
Switch		



H. Select the correct safety rules for the portable drill by placing either safe or unsafe in each of the blanks below.

_____ 1. Use the correct drill bit.

_____ 2. Mount the drill bit firmly.

_____ 3. Hammer the chuck key tight.

_____ 4. Make sure the drill bit runs true.

_____ 5. Mount the work firmly so it will not turn.

_____ 6. Make sure the drill will provide the correct RPM for the drill bit being used.

_____ 7. Hold the drill with one hand.

_____ 8. Keep the drill aligned with the hole while drilling.

_____ 9. Never withdraw the drill until the hole is through.

UNIT TEST--PART 6

A. Answer the following statements true or false by placing a T for True or an F for False in the space provided.

_____ 1. Solderless connectors use melted metals to join parts.

_____ 2. Solderless connectors are easy to use.

_____ 3. One size of solderless connector is all you need.

_____ 4. Several electrical wires may be held together using solderless connectors.

_____ 5. Plastic end caps are a common type of connector.

B. List the four steps in using end caps.

1.

2.

3.

4.

C. Answer the following statements true or false by placing a T for True or an F for False in the space at the left.

_____ 1. Taping is required to protect the splice from rust.

_____ 2. One wrap of tape is usually enough protection.

_____ 3. Tape should not be stretched as it is applied.

_____ 4. Taping should provide as much insulation as the original covering.

_____ 5. Taping is also used to insulate.

ELECTRICIAN'S HELPER

UNIT TEST--PART 7

A. Answer the following statements true or false by placing a T for True or an F for False in the blanks at the left.

_____ 1. In some cases studs may have to be notched.

_____ 2. Holes should be drilled as straight as possible in studs.

_____ 3. When studs are notched, a steel plate of at least 3/4-inch diameter must be used to cover the notch.

_____ 4. Cable insulation should be removed after installation into the box.

_____ 5. Cable should be cut, then pulled to its proper place.

_____ 6. When floor joists are notched, a steel plate of at least 1/16-inch in diameter must be used.

_____ 7. Holes should be drilled in the center of studs if possible.

_____ 8. Cable should be pulled to its proper place, then cut to length. This helps avoid excess waste.

ELECTRICIAN'S HELPER

UNIT TEST--PART 8

A. List the five things electrical boxes are made of.

1.

2.

3.

4.

5.

B. List the four main types of boxes and their uses.

1.

2.

3.

4.

C. List five rules concerning the use of boxes.

1.

2.

3.

4.

5.

D. Arrange the following in the correct order by placing numbers in the blanks.

EXAMPLE: "1" is the first step, "2" is the second, etc.

_____ 1. Find box mounting holes and recess depth mark on box.

_____ 2. Hold box in desired position.

_____ 3. Check box to be sure it is held tightly in place.

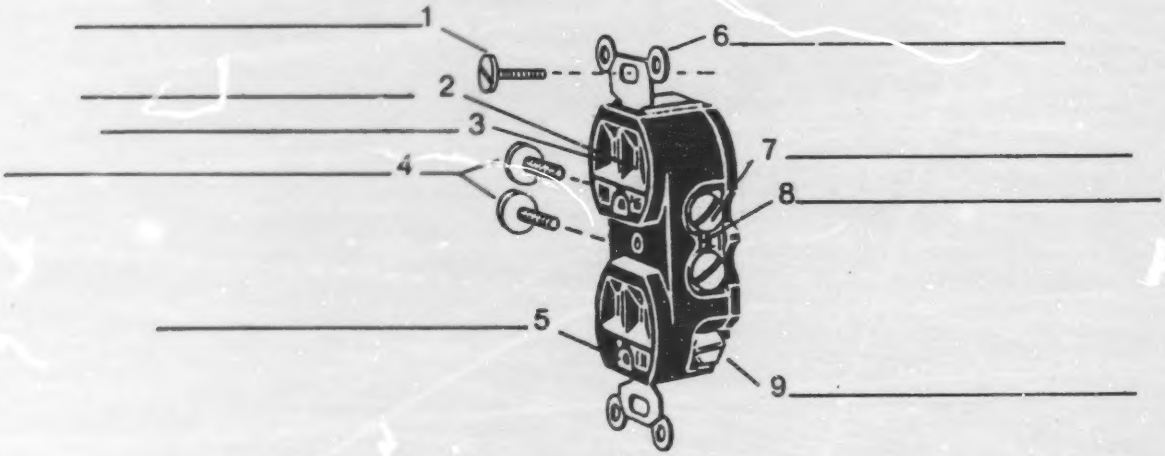
_____ 4. Decide which nail holes to use.

_____ 5. Find where the outlet box should go.

_____ 6. Drive nails through holes into stud.

UNIT TEST--PART 9

A. Label the parts of the receptacle.



B. Match the color-coded screws to what they stand for by placing the correct letter in the blanks at the left.

_____ 1. Silver-colored screws   a. Ground terminal

_____ 2. Bronze-colored screws   b. Neutral terminal

_____ 3. Green-colored screws   c. Hot terminal

C. List four types of switches.

1.

2.

3.

4.

UNIT TEST--PART 10

A. List the five different types of fixtures.

1.

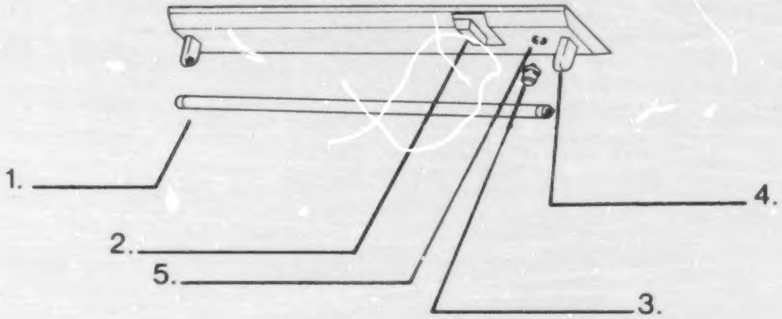
2.

3.

4.

5.

B. Label the five parts of a fluorescent lamp.



C. List the five major steps in installing light fixtures.

1.

2.

3.

4.

5.

UNIT TEST--PART 11

A. Answer the following statements true or false by placing a T for True or an F for False in the blanks at the left.

_____ 1. EMT must be deburred after cutting.

_____ 2. Trade sizes range from three to four inches.

_____ 3. EMT is usually purchased in bundles of 10 feet.

_____ 4. There is one size of EMT, rigid thick wall.

_____ 5. A hacksaw is usually used to cut conduit.

_____ 6. EMT is bent with a conduit hickey.

_____ 7. EMT comes in various sizes.

_____ 8. A level is used to check 90° bends.

_____ 9. Saddles are used to go around obstructions.

_____ 10. Back-to-back bends are simply two 45 degree bends together.

B. List the four steps in making a back-to-back bend.

1.

2.

3.

4.